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# An assessment of the cod stock in NAFO Subdiv. 3Ps in October 2001

# Évaluation d'octobre 2001 du stock de morue de la sous-division 3Ps de l'OPANO

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## Abstract

This document summarizes scientific information used to determine the status of the cod stock in NAFO Subdivision 3Ps off the south coast of Newfoundland on 1 April 2002 and evaluates alternative TAC options for the management year 1 April 2002 – 31 March 2003. Assessments prior to 2000 provided scientific advice on a calendar year basis, but the management year was changed during 2000 to begin on 1 April 2000 and end 31 March 2001. Sources of information available for this assessment were: reported landings from commercial fisheries (1959-March 2001), oceanographic data, a time series (1973-2001) of abundance and biomass indices from Canadian winter/spring research vessel (RV) bottom-trawl surveys, an industry offshore bottom-trawl survey, inshore sentinel surveys (1995-2000), science logbooks from vessels <35ft (1997-2000), logbooks from vessels >35ft (1998-2000), and tagging studies (1997-2001). The fishery was still in progress at the time of the assessment and complete information on catch rates and age compositions from the 15,000 t TAC from 1 April 2001 – 31 March 2002 was not available. Several sequential population analyses (SPA) were carried out using reported commercial catches, calibrated with Canadian RV survey data, standardized annual catch rate-at-age indices for line-trawl and gillnet from the sentinel survey, and industry trawl survey data. In some SPA runs, the RV surveys were treated as two indices, one for the eastern and one for the western portion of the stock area, as described in Brattey et al (2000). Spawner biomass estimates for 1 April 2001 from the various sequential population analysis formulations considered covered a wide range, and no single SPA run was considered to best represent absolute population size; however, estimated trends in spawner biomass were similar. All the sequential population analyses indicated that spawner biomass increased during 1993-1998 but declined during 1998-2001. Spawner biomass is not being sustained by recent recruitment and the present assessment predicts that spawner biomass will decline further in 2001-2002 assuming the 15,000 t TAC is caught. However, a notable finding in this assessment was that the 1997 and 1998 year classes appear to be much stronger than those produced during 1991-1996. These encouraging signs of improved recruitment are likely to result in an increase in population biomass and spawner biomass in the next few years. Several risk analyses based on different SPA formulations were used to propagate the uncertainty in the estimated population size to 1 April 2003, under a range of TAC options for the 2002-2003 fishing season. Risk analyses indicate it is unlikely that spawner biomass will decline further in 2001-2002 at catch levels between 10,000 t and 20,000 t. The risk of exceeding the $F_{0.1}$ limit reference level was greater than 5% in 2 of the 5 formulations for a TAC of 10,000 t and greater than 5% in 3 out of 5 formulations for a TAC of 15,000 t. The risk of exceeding the target reference point of half $F_{0.1}$ was above 50% for 3 out of 5 formulations at a TAC of 10,000 t and above 50% for 4 out of 5 formulations for a TAC of 15,000 t. These risk analyses do not take into account uncertainties associated with the stock composition of the commercial catch, misreported catches and assumptions about natural mortality.

## Résumé

Nous présentons un résumé des données scientifiques que nous avons utilisées pour établir l'état du stock de morue de la sous-division 3Ps de l'OPANO, bordant la côte sud de Terre-Neuve, le 1er avril 2002, et une évaluation d'autres options de TAC pour la période de gestion allant du 1er avril 2002 au 31 mars 2003. Les évaluations réalisées avant l'an 2000 donnaient des avis scientifiques couvrant l'année civile, mais l'année de gestion a été modifiée en 2000, de sorte qu'elle commençait le 1er avril 2000 et se terminait le 31 mars 2001. La présente évaluation fait appel aux sources de renseignements suivantes : les rapports des débarquements des pêcheurs commerciaux (1959-mars 2001), des données océanographiques, une série chronologique (1973-2001) d'indices d'abondance et de biomasse issus de relevés canadiens de navire de recherche menés en hiver et au printemps au chalut de fond, un relevé hauturier au chalut de fond effectué par l'industrie, des relevés côtiers par pêche sentinelle (1995-2000), les renseignements scientifiques tirés des journaux de bord des bateaux < 35 pi (1997-2000), les journaux de bord des bateaux > 35 pi (1998-2000) et des études d'étiquetage (1997-2001). Comme la pêche battait encore son plein lorsque l'évaluation a été faite, de l'information complète sur les taux de capture et la composition par âge des prises issues du TAC de 15 000 t à récolter entre le 1er avril 2001 et le 31 mars 2002 n'était pas disponible. Nous avons effectué plusieurs analyses séquentielles de population (ASP) reposant sur les prises commerciales déclarées, étalonnées à l'aide des données de relevés canadiens de NR, des indices annuels normalisés des taux de capture selon l'âge à la palangre et aux filets maillants obtenus lors du relevé par pêche sentinelle, et des données issues du relevé au chalut de l'industrie. Dans certains passages des ASP, nous avons traité les relevés de NR comme deux indices, l'un portant sur la partie est et l'autre sur la partie ouest de la zone du stock, comme le décrivent Brattey et al (2000). Les estimations de la biomasse de reproducteurs pour le 1er avril 2001 issues des diverses expressions des ASP considérées étant très variables, nous n'avons considéré aucun passage particulier d'ASP comme représentant le mieux la taille absolue de la population, quoique les tendances estimées de la biomasse de reproducteurs étaient semblables. Toutes les ASP ont indiqué que celle-ci a augmenté de 1993 à 1998, pour ensuite diminuer de 1998 à 2001. Le recrutement récent ne suffit pas pour la maintenir et nous sommes d'avis qu'elle diminuera davantage en 2001-2002 si le TAC de 15 000 t est récolté. Un résultat remarquable de la présente évaluation est les classes d'âge 1997 et 1998 semblent beaucoup plus abondantes que celles produites pendant la période 1991-1996. Ce recrutement meilleur, très encourageant, donnera probablement lieu à une augmentation de la biomasse de la population et de la biomasse de reproducteurs au cours des prochaines années. Nous avons utilisé plusieurs analyses du risque reposant sur diverses expressions des ASP pour propager l'incertitude entourant la taille estimée de la population jusqu'au 1er avril 2003, suivant une gamme d'options de TAC pour la saison de pêche 2002-2003. Les analyses du risque révèlent qu'il est peu probable que la biomasse de reproducteurs diminuera davantage en 2001-2002 à des niveaux de prises se situant entre 10 000 t et 20 000 t. Le risque de dépasser le niveau de référence F0,1 était supérieur à 5 % d'après 2 des 5 expressions à un TAC de 10 000 t et supérieur à 5 % d'après 3 des 5 expressions à un TAC de 15 000 t. Le risque de dépasser le point de référence cible de la moitié de F0,1 était supérieur à 50 % d'après 3 des 5 expressions à un TAC de 10 000 t et supérieur à 50 % d'après 4 des 5 expressions à un TAC de 15 000 t. Ces analyses du risque ne tiennent pas compte des incertitudes reliées à la composition des prises commerciales, des erreurs de déclaration des prises et des hypothèses au sujet de la mortalité naturelle.

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## 1. Introduction

This document gives the results of the regional assessment of Atlantic cod (*Gadus morhua*) in NAFO Subdiv. 3Ps conducted in St. John's during 18-26 October 2001. Following a 4 year moratorium that began in August 1993, the directed cod fishery in this area was reopened in May 1997 with a TAC set at 10,000 t. The TAC was subsequently increased to 20,000 t for 1998 and to 30,000 t for 1999. In addition, an interim TAC of 6,000 t was set for the first 3 months of year 2000 to initiate a new management year beginning 1 April 2000 and ending 31 March 2001. The TAC for 1 April 2000 – 31 March 2001 was set at 20,000 t and the TAC for the subsequent management year (1 April 2001 – 31 March 2002) was set at 15,000 t.

The history of the cod fishery in NAFO Subdivision 3Ps, located off the south coast of Newfoundland (Fig. 1, 2), and results from other recent assessments of this stock, are described in detail in previous documents (Pinhorn 1969; Bishop et al. 1991, 1992, 1993, 1994, 1995; Shelton et al. 1996; Stansbury et al. 1998; Brattey et al. 1999a, b, 2000).

The present assessment incorporates all available information on 3Ps cod, including the April 2001 research vessel bottom-trawl survey data and a portion of the 2001 catch-at-age data from the commercial fishery, which was still in progress at the time of the assessment meeting. Detailed information on catch-at-age up to the end of March 2001 was available and preliminary catch at age information up to the end of August 2001 was also used in the assessment. Additional sources of information available for the current assessment included: oceanographic data, science logbooks for vessels <35ft (1997-2000), industry logbooks for vessels >35ft (1998-2000), an industry trawl survey on St. Pierre Bank (1997-2000), inshore sentinel surveys (1995-2000), recaptures of tagged cod (received up to 30 September 2001) from tagging experiments conducted during 1997-2001, and data from acoustic studies. Details of the information presented at the meeting are given in Shelton (2002).

In the current analyses it was assumed that the entire 15,000 t TAC would be taken in the fishing season from 1 April 2001 to 31 March 2001, as outlined in the management plan released by DFO prior to the start the season. The current assessment provides a revised estimate of the abundance of fish on 1 April 2001. Numbers at age are first projected to 1 April 2002 by accounting for recorded catch up to the end of August 2001 and assumed catch for the remainder of the season to 31 March 2002. In a second step, numbers are projected to 31 March 2003 under a number of TAC options for the 2002/2003 season. Uncertainty in estimated parameters that relate to stock size are propagated forward in the projections. Analyses are performed of the risk of the spawner biomass not increasing and of fishing mortality exceeding a tentative limit reference level of $F_{0.1}$ and a tentative target reference level of half $F_{0.1}$. Precautionary biological reference points have yet to be agreed on for this stock.

## 2. Environmental overview

Oceanographic data from NAFO subdivisions 3Pn and 3Ps during the spring of 2000 and 2001 were examined and compared to the long-term (1971-2000) average (see Colbourne 2001). The temperature and salinity data can be examined in several ways: as vertical transects across the major banks and channels, horizontal bottom maps, time series of areal extent of bottom water in selected temperature and salinity ranges and as time-series of temperature anomalies.

Temperature anomalies on St. Pierre Bank show anomalous cold periods in the mid-1970s and from the mid-1980s to mid-to-late 1990s. During the most recent cold period, which started around 1985, temperatures were up to 1°C below average near bottom and up to 2°C below the warmer temperatures of the late 1970s and early 1980s in the surface layers. Temperatures in deeper water off the banks during all years show significant variations, but remained relatively warm with values in the 3-6°C range compared to the much colder values (often sub-zero °C) on St. Pierre Bank during most years. Beginning around 1996 temperatures started to moderate, decreased again during the spring of 1997 and returned to more normal values during 1998.

During 1999 and 2000 temperatures continued to warm to above normal values over most of the water column. During the spring of 2001 however, temperatures cooled significantly over the previous two years to values observed during the mid-1990s. The areal extent of <0°C bottom water increase significantly from the mid-1980s to mid-1990s, but decreased to very low values in 1998-2000. During 2001 it increased again, returning to values observed during the mid-1990s. Since 1995 the areal extent of bottom water with temperatures >1°C has been increasing, reaching pre-1985 values by 1999-2000. During 2001 however, the area of warmer water decreased significantly compared to the pervious 2-years. On St. Pierre Bank, <0°C water completely disappeared during 1999-2000 but increased to near 30% during 2001. The area of near-bottom water on the banks with temperatures >1°C was about 50% of the total area during 1998 the first significant amount since 1984. This increased to about 70% during 1999 and to 85% during 2000 but decreased to a very low area during 2001.

In general, the oceanographic data show significant variations in water mass characteristics, particularly on St. Pierre Bank during the past several years, with cold near-constant salinity water from 1990 to 1997, changing to warmer-saltier conditions during 1998 and 1999 and decreasing to fresher, but still warm conditions during 2000. During 2001 salinities increased to above normal values while temperatures generally decreased to below normal values.

## 3. Commercial catch

Catches (reported landings) from 3Ps for the period 1959 to 31 March 2001, by country and separated for fixed and mobile gear, are summarized in Table 1 and Fig 3. Canadian landings for vessels <35 ft were estimated mainly from purchase slip records collected and interpreted by Statistics Division, Department of Fisheries and Oceans prior to the moratorium. Shelton et al. (1996) emphasized that these data may be unreliable. Post-moratorium landings for vessels <35 ft have come mainly from a new dock-side monitoring program. Landings for vessels >35 ft come from logbooks. Non-Canadian landings (mainly France) are compiled from national catch statistics reported by individual countries to NAFO and there is generally a two to three year lag in the submission of final statistics; consequently, the most recent entries in Table 1 are designated as provisional.

The stock in the 3Ps management unit was heavily exploited in the 1960's and early 1970's by non-Canadian fleets, mainly from Spain and Portugal, with reported landings peaking at about 87,000 t in 1961 (Table 1, Fig. 3a). After extension of jurisdiction (1977), cod catches averaged between 30,000 t and 40,000 t until the mid-1980's when increased fishing effort by France led to increased total landings, reaching a high for the post-extension of jurisdiction period of about 59,000 t in 1987. Subsequently, catches declined gradually to 36,000 t in 1992. Catches clearly exceeded the TAC throughout the 1980's and into the 1990's. The Canada-France boundary dispute led to fluctuations in the French catch since the late 1980's. A moratorium was imposed on all directed cod fishing in August 1993 after only 15,216 t had been landed, the majority being taken by the Canadian inshore fixed gear fishery. In this year access by French vessels to Canadian waters was restricted. Under the terms of the Canada-France agreement, France is allocated 15.6% of the TAC, of which Canadian trawlers must fish 70%, with the remainder fished by small inshore fixed gear vessels.

In 1997, 72% of the 10,000 t TAC was landed by Canadian inshore fixed gear fishermen, with most of the remaining catch taken by the French mobile gear sector fishing the offshore (Table 1, Fig. 3b). In 1998, approximately 57% the 20,000 t TAC was taken by the Canadian inshore fixed gear sector, with 34% taken by the Canadian and French mobile gear sectors fishing the offshore. In 1999, over 21,230 t or approximately 71% of the TAC was taken by the Canadian inshore fixed gear sector, with most of the remainder taken by Canadian and French mobile gear sectors fishing offshore. During the first three months of 2000, there were substantial landings from both the Canadian and French mobile gear sectors fishing the offshore (1,544 t and 2,460 t, respectively). The Canadian inshore fixed gear sector reported landings of 3,301 t during this period. During the 2000 calendar year, total reported landings were 25,100 t of which 65% was landed by the inshore fixed gear sector, and most of the remainder (29%) by the offshore mobile gear sector. In the 2001 calendar year to the end of September, the inshore fixed gear sector has accounted for 70% of the reported landings; the mobile gear sector typically catches most of its allocation in the late fall and early winter.

Line-trawl catches dominated the fixed gear landings over the period 1977 to 1993, reaching a peak of over 20,000 t in 1981 (Table 2, Fig. 4). In the post-moratorium period, line-trawls have accounted for 15.9 to 21.7% of the fixed gear landings. Gillnet landings increased steadily from 1978 to a peak of over 9,000 t in 1987 and then declined until the moratorium. However, gillnets have been responsible for the dominant portion of the inshore catch since the fishery reopened in 1997, with gillnet landings exceeding 10,000 t (i.e. 50% of the TAC) for the first time in 1998, and approaching 18,000 t in 1999. Gillnets are also being used in the offshore areas (see below). Trap catches have varied over the time period, but have not exceeded 8,000 t and have declined from 1,167 t to negligible amounts from 1998 onwards. Hand-line catches have been a minor (<3,000 t) component of the fishery prior to the moratorium and accounted for a small fraction of landings during 1998-2000; however, the hand-line catch for 2001 (to October) shows a substantial increase over the 1998-2000 period.

Landings are summarized by month, for inshore and offshore, each gear sector separately, for both 2000 and 2001 (January to September) in Table 3a. Inshore catches have come mostly from gillnets with substantial landings in all months except April and May. Line-trawls were fished inshore mostly during September-December. In the offshore, otter trawl (and Norwegian seine) fishing by Canadian trawlers and vessels chartered by St. Pierre and Miquelon to fish the French quota was concentrated mainly during the first and last quarters of the year. There was also a substantial offshore gillnet catch in 2000 with landings totaling over 4,000 t taken mostly during June-December. Overall, landings in 2000 were dominated by the directed gillnet fishery with the remaining catch taken by otter trawl, followed by line-trawl, hand-line, and trap. The gillnet fishery was pursued over a longer period of the year than the traditional gillnet season for 3Ps, most notably during January-March. Also more fishers west of the Burin Peninsula were reported to be using gillnets in 2000 rather than the traditional line-trawl.

The landings for 2000 and the first nine months of 2001 are summarized by month, unit area, and calendar year in Table 3b and by the 2000/2001 management year in Table 3c. In contrast to 1997-1999, there were substantial inshore landings in first three months of 2000 in 3Psc (February) and to a lesser extent 3Psa and 3Psb (March). Inshore landings in April and May 2000 were low and came mostly from by-catch fisheries. There were substantial landings in all inshore unit areas during June and July 2000, particularly in Placentia Bay with reported landings of over 2,400 t. Landings from inshore areas were low in August 2000, but increased in September and in November. As in previous years, there were substantial landings (2,412 t) in Placentia Bay during November. In the offshore, landings tended to be higher in fall and winter and low during the summer months (June-August). Preliminary landings for the 2001 calendar year show similar spatial and temporal trends to those seen in 2000, but with less inshore catch during the first three months.

The distribution of post-moratorium catches among unit areas is illustrated in Fig. 5. The inshore (3Psa, 3Psb, and 3Psc) has consistently accounted for most of the reported landings. The landings have typically been highest in Placentia Bay (3Psc), ranging from 4,000 t to almost 12,000 t with typically 30-50% of the entire TAC coming from this unit area alone. Landings from 3Psa and 3Psb have been fairly consistent at about 1,000-3,000 t and generally 5-12% and 9-22% of the TAC, respectively. Most of the offshore landings have come from 3Psh and 3Psf (Halibut Channel and the southeastern portion of St. Pierre Bank).

The 1 April 2000 to 31 March 2001 conservation harvesting plan placed various restrictions on how the 3Ps fishery could be pursued. Unit area 3Psd was closed during directed cod fishing from 15 November to 15 April during 1998-1999, 1999-2000, and 2000-2001, based on the possible mixing of northern Gulf cod into the 3Ps stock area at this time of year. From 1997 to 31 March 2001, fishers with homeports west of the Burin Peninsula fished competitively with quarterly quotas, but an IQ system was introduced in this area starting in the 2001/2002 management year. In contrast, fishers in Placentia Bay have operated under an individual quota (IQ) system since 1998. A dockside monitoring system was introduced following the reopening of the fishery, and other restrictions, many of which varied according to vessel class, have included the amount of gear that could be fished, where fish could be landed, trip and weekly limits, and a small fish limit. Mesh size of gillnets was also restricted to a maximum of 6.5 inches. During the current management year, use of gillnets was initially restricted to 40% of the vessel IQ with the remainder to be caught by hook and line (hand-line or long-line) and gillnets were no longer permitted after September. There were reports of extensive dumping and discarding as a consequence of size and quality based price differentials in the 1999 fishery and the 40% restriction was imposed in an attempt to reduce discarding resulting from prolonged soak times when nets could not be retrieved in adverse fall weather. However, the restriction was lifted during mid-October following extensive complaints from industry. It was also noted during the assessment meeting that the 6.5" mesh limit in the directed cod fishery could be circumvented by gill-netters fishing the offshore portion of 3Ps because they could use much larger mesh size (8" and 10") when fishing for other species such as skate and white hake and still keep cod as bycatch.

## 3.1 Catch-at-age

Samples of length and age composition of catches were obtained from the inshore trap, gillnet, line-trawl and hand-line fisheries and the offshore otter trawl, gillnet, and line-trawl fisheries by port samplers and fishery observers. Sampling of the catch in 2000 was intensive, with 11, 800 otoliths collected for age determination and over 198,600 fish measured for length (Table 4). The sampling was well distributed spatially and temporally across the gear sectors. Substantial landings in from inshore fixed gears (see Table 3) were sampled intensively, particularly line-trawl and gillnet. The smaller number of samples from hand-line and offshore line-trawl catch reflects the smaller catches from these gears in 2000. Sampling for 2001 will be reviewed in the next assessment.

The age composition and mean length-at-age of commercial catches were calculated as described in Gavaris and Gavaris (1983). The average weights were derived from a standard length-weight relationship where log(weight)=3.0879*log(length)-5.2106. Catch-at-age for all gears combined based on sampling of Canadian and French vessels in 2000 and January to March in 2001 is summarized in Table 5a, 5b and Fig. 6. In the 2000 landings from all gears combined, ages 5 to 11 were well represented (1989 to 1995 year classes) with age 7 (1993 year class) the most abundant overall. The age composition of the catch from the first three months of 2001 showed a similar composition to that of the preceding year, with ages incremented by one year, i.e. ages 6-12 predominating. Catch at age by gear type for 2000 and January-March 2001 is illustrated in Fig. 7. The dominance of gillnet selectivity on ages 6 to 9 is apparent in both years. In comparison, line-trawls selected mostly ages 4 to 7. Offshore mobile gear showed the presence of fish aged 10-11 in 2000 and 11-12 in 2001.

A time series of catch numbers-at-age for the 3Ps cod fishery from 1959 to 2001 is given in Table 6. For the 2000 fishery, two age compositions are given; one based on sampling information for January-March that was available for the October 2000 assessment, and a final age composition for 2000 that was used in the current assessment. The final catch in 2000 was dominated by 6-8 year-old cod (1992 year class) although in terms of numbers 4-11 year olds are also well represented. There were some notable differences in age composition between the January-March and final 2000 age compositions, notably a decrease in the representation of 8 year olds and an increase in 4 year olds.

For the 2001 fishery, two age compositions are also given; one based on sampling information for January-March that was available for the current assessment, and the other is a projected final age composition for January to December 2001. To get the preliminary 2001 catch at age, the catch at age for the period April-August 2001 was bumped up to get the total projected catch weight for April to December 2001 and then added to the January to March 2001 catch at age. The catch in January-March 2001 was dominated by 7-9 year-old cod (1992-1994 year classes) although 12 year olds (1989 year class) are still reasonably well represented. The projected catch at age for the whole year based on the additional sampling from April to August suggests that age 6 fish will also contribute a significant amount.

Mean annual weights-at-age in the commercial catch in 3Ps (including food fisheries and sentinel survey catches), calculated from mean lengths-at-age, are given in Table 7a and Fig. 8a. Beginning of the year weights-at-age, calculated from commercial mean annual weights-at-age as described in Lilly (1998), are given in Table 7b and Fig. 8b. Current weights of younger fish (3-6) tend to be higher than those reported for the 1970's and early 1980's, whereas for older fish the converse is true. Sample sizes for the oldest age groups (>10) have been low in recent years due to scarcity of old fish in the catch. Furthermore, as Lilly et al. (1999) point out for 2J3KL cod, interpretation of these trends is difficult because of changes in the relative contribution of various gear components and changes in the location and timing of catches. The higher proportion of gillnet landings in 3Ps, particularly in 1998 and 1999, could increase the mean weight-at-age of the younger ages, because only the fastest-growing, largest individuals within a cohort would be caught by this gear.

## 4. Sentinel survey

The sentinel survey has been conducted in 3Ps since 1995 and there are now five complete years of catch and effort data (see Maddock-Parsons and Stead 2001). During 2000 the sentinel survey continued to produce a time series of catch/effort data and biological information collected by trained fish harvesters at various inshore sites along the south coast of Newfoundland. There were 16 active sites in 3Ps, using predominantly gillnets (5½ " mesh) in unit area 3Psc (Placentia Bay) and line-trawls in 3Psb and 3Psa (Fortune Bay and west). One 3¼ " gillnet is also fished at each of 4 sites in Placentia Bay one day per week. Fishing times averaged 9 weeks in 2000 as opposed to 6 weeks in 1999 and 12 weeks from 1995-1998. Most fishing takes place in fall/early winter. Maddock-Parsons and Stead (2001) produced a time series of weekly average catch rates and annual relative length frequencies (number of fish at length divided by amount of gear). Catch rates in those locations that fished in 2000 were generally lower than those reported for comparable times in preceding years, and preliminary indications are that these rates are low in 2001 although some areas are showing an increase over the previous year.

As in the previous two assessments, an attempt was made to produce an age dis-aggregated index of abundance for the five completed years in the gillnet (5½ " mesh) and line-trawl sectors of the program; there is insufficient data from the 3¼ " gillnets to develop an index for this gear. Sentinel fishers typically fish a control and an experimental site; the location of the control site is fixed, whereas the location of the experimental site can change only within the local area.

### 4.1 Standardized sentinel catch rates

The catch from 3Ps was divided into cells defined by gear type (5½" mesh gillnet and line-trawl), area (unit areas 3Psa, 3Psb, 3Psc), year (1995-2000) and quarter. Age-length keys were generated for each cell using fish sampled from both the fixed and experimental sites; however, only fish caught at the fixed sites were used to derive the catch rate indices. Length frequencies and age-length keys were combined within cells. The numbers of fish at length are assigned an age proportional to the number at age for that particular cell length combination. Fish that were not assigned an age because of lack of information within the initial cell were assigned an age by aggregating cells until the data allowed an age to be assigned. For example, if there are no sample data in a quarter then quarters are combined to half-year, half-years are combined to year; if an age still cannot be assigned, then areas are combined for the year.

Catch-at-age and catch per unit effort (CPUE) data were standardized using a generalised linear model to remove site and seasonal effects. For gillnets, only sets at fixed sites during July to November with a soak time between 12 and 32 hours were used in the analysis. For line-trawl, sets at fixed sites during August to November with a soak time less than or equal to 12 hours where used in the analysis. Zero catches were generated for ages not observed in a set. Sets with effort and no catch are valid entries in the model. Note that catch rates from the sentinel fishery are expressed in terms of numbers of fish, rather than catch weight as was used in the analyses of logbook data. This has important implications when comparing trends in these indices.

A generalized linear model (McCullagh and Nelder 1989) was applied to the sentinel catch and effort data for each gear type. The response distribution was specified as Poisson and the link function was chosen to be log. That is, the Poisson mean parameter $\mu$, is related to the linear predictor by

$$\log(\mu_i) = X_i'\beta$$

where $X_i'$ is a vector of explanatory factors for catch observation $I$ (i.e. month, site age and year) and $\beta$ is a vector of coefficients to be estimated from the data.

Thus catch is assumed to have a Poisson probability distribution with the mean $\mu_i$ related to the factors month nested within site and age nested within year by

$$\log(\mu_i) = \log(E_i) + month_i(j)\beta_j(site_i(k)\beta_k) + age_i(l)\beta_l(year_i(m)\beta_m),$$

where $E_i$ is and offset parameter for fishing effort and $j,k,l,m$ indicate the level for each of the four factors.

In the present assessment, the model adequately fitted data from gillnets and line-trawls and two standardized annual catch rate-at-age indices were produced, one for each gear type. All effects included in the model were significant. The standardised gillnet and line-trawl catch rate-at-age indices for 1995 to 2000 are given in Table 8. For gillnets, the catches during 1995-1997 were dominated by the 1989 and 1990 year-classes and for the subsequent period the 1992 year-class is well represented, although catch rates for the latter do not appear to be as strong. For line-trawls, catch rates were higher for the 1989 and 1990 year-classes during 1995 to 1996 followed by the weaker 1992 year-class. A notable finding is the relatively strong appearance of 3 year and 4 year old fish (1996 and 1997 year-classes) in the 2000 line-trawl catches. Overall both indices are reasonably consistent, with the relatively strong 1989 and 1990 year classes passing through the fishery and being replaced weaker year classes. There are indications of improving recruitment in the most recent year for line-trawls, although this trend is not evident in the gill-net catch rates.

Annual trends in standardized total (ages 3-10 combined) annual catch rates, expressed in terms of numbers of fish, are shown in Fig. 9. For gillnets there is no trend over the period 1995-1997 and a decline thereafter. For line-trawls there is a decline until 1999, followed by an increase in the most recent year. As described in previous assessments (Brattey et al. 1999a, b, 2000) there is speculation that commercial fisheries during 1997-2000 may have had some disruptive influence on the execution of the sentinel fishery. Competition with commercial fishers for fishing sites, local depletion, inter-annual changes in the availability of fish to inshore, and shifts in the timing of sentinel fishing to accommodate periods of commercial fishing could all influence mean catch rates between years. The extent to which such effects influence catch rates are not fully understood. The decline in sentinel catch rates since the fishery re-opened was interpreted as cause for concern; however, the signs of improved catch rates of young fish in line-trawl in 2000 are consistent with trends seen in other indices (DFO RV survey and GEAC survey, see below) and provide further support for the suggestion that recruitment is improving.

## 5. Science logbooks

A new science logbook was introduced to record catch and effort data for vessels less than 35 ft in 1997. The purpose of this logbook is for scientific stock assessments and not for quota monitoring or other controls on the fishery. Previously only purchase slip records were available for these size vessels, containing limited information on catch and no information on effort. Catch rates have the potential to provide a relative index of temporal and spatial patterns of fish density, which may relate to the overall biomass of the stock. There are currently data for more than 37,800 gillnet sets and 11,300 line-trawl sets in the database. These data pertain to the inshore fishery, i.e. unit areas 3Psa, 3Psb, and 3Psc.

In the present assessment, effort was treated as simply the number of gillnets, or hooks for line-trawls (1000's), deployed in each set of the gear; soak times were not adjusted as the relationship between soak time, gear saturation and fish density is not known. Catch rates were expressed in terms of weight; catches are generally landed as head-on gutted and recorded in pounds; these were converted to kg by multiplying by 2.2026.

As observed in the October 1999 and October 2000 assessments, preliminary examination of the logbook data indicated that soak time for gillnets is most commonly 24 hours with 48 hours the next most common time period. In comparison, line-trawls are typically in the water for a much shorter period of time – typically 2 hours with very few sets more than 12 hours. In addition, the distribution of catches per set is skewed to the right for most gears (not shown). For gillnets, catches per set are typically 100-200 kg with a long tail on the distribution extending to 2 tons. The distribution of catches for line-trawls was similarly skewed.

In previous assessments, an exploratory analysis of science logbook data was conducted to investigate spatial and temporal trends in catch rates at the level of unit areas and lobster management areas (Brattey et al 1999a, b, 2000) as the time series of science logbook data covered only three years. However, in the current assessment 4 years of data were available and an attempt was made to develop a catch rate index from these data. The same generalised linear model approach to that described above for the sentinel fishery was adopted, except that age composition data were not directly available for the logbook data so that the age effect is dropped. In addition, catch rates from logbooks were expressed in terms of weight, whereas sentinel catch rates were expressed in terms of numbers of fish. In a similar approach to that adopted for the sentinel survey data, the response distribution was specified as Poisson and the logarithmic link function was used.

The catch from 3Ps was divided into cells defined by gear type (gillnet and line-trawl), statistical area (numbered 29-37 and illustrated in Fig. 10a), and year (1997-2000). Catch per unit effort (CPUE) data were standardised to remove site and seasonal effects. Gillnet sets where the number of nets used was >30 were excluded to remove offshore gillnet activity from the analysis. Similarly, line-trawl sets where the number of hooks was <100 or >4,000 were excluded. Sets with effort and no catch are valid entries in the model.

In the present assessment, the model adequately fitted data from gillnets and line-trawls and two standardized annual catch rate indices were produced, one for each gear type. All effects included in the model were significant. Preliminary analyses indicated that catch rates were generally higher for both line-trawl and gillnet in Placentia Bay compared to inshore areas further west. Overall, there has been a general downward trend in catch rates over time for both gear types (Fig. 10b). For gillnets, the catch rates have declined from 26.5 kg per net in 1997 to 12.0 kg per net in 2000. For line-trawls, catch rates were highest in 1997 at 238 kg per 1,000 hooks and have declined to around 186 kg per hook in 1999 and 2000.

The observed trends in commercial catch rate indices for the inshore fishery are influenced by many factors. There have been substantial annual changes in the management plans in the post-moratorium period, with respect to timing of the 3Ps cod fishery, amount of gear fished, trip and weekly limits, as well as a trend toward individual quotas (IQ's) rather than a competitive fishery. In addition, experience has shown that catch rates from mobile commercial fleets can be related more to changes in the degree of local aggregation and be a poor reflection of overall trends in stock abundance, particularly for stocks in decline. While this is likely to be a bigger problem with respect to trawl derived catch rates, gillnets and line-trawls can also be deployed to target local aggregations. For inshore fisheries, catch rates can also be strongly influenced by annual variability in the extent and timing of inshore and long-shore migration patterns. Consequently, inshore commercial catch rate data must be interpreted with caution. Where these data can be disaggregated into ages independently of the commercial catch at age data (as is the case with the sentinel survey) the information may be more easily interpreted in terms of stock size. Despite these issues, the declines in gillnet and line-trawl catch rates since the fishery re-opened in 1997 are cause for concern. The more stable catch rates for line-trawl in the past two years may, however, be reflecting the improved recruitment that is evident in other indices for the 3Ps stock (DFO RV survey, GEAC survey, sentinel line-trawl).

## 6. Tagging experiments

A Strategic Project involving tagging of adult (> 45 cm) cod continued during 2001 with an additional 8,006 tagged fish released in 3Ps up to 30 September 2001. Recoveries of tagged cod from the fishery are used to provide information on movement patterns and to estimate exploitation rates in different regions of the stock area. As in previous years single, double, and high-reward tags were applied, and tagging was conducted on spawning and pre- and post-spawning aggregations in the following areas: Halibut Channel (3Psh), Burgeo Bank-Hermitage Channel (3Psd), Fortune Bay (3Psb), and Placentia Bay (3Psc). A new area of coverage in 2001 was northwest St. Pierre Bank (3Psd). Total numbers of cod released in 3Ps and reported as recaptured annually (up to 30 September 2001*) from all areas combined are shown below.

| | | **Number reported as recaptured** | | | | |
|---|---|---|---|---|---|---|
| **Year released** | **Number tagged** | **1997** | **1998** | **1999** | **2000** | **2001*** |
| 1997 | 6029 | 342 | 365 | 467 | 239 | 39 |
| 1998 | 9941 | . | 544 | 1064 | 555 | 96 |
| 1999 | 8450 | . | . | 661 | 808 | 139 |
| 2000 | 9900 | . | . | . | 668 | 384 |
| 2001 | 8006 | . | . | . | . | 235 |

Approximately 6,000 to 10,000 cod have been tagged and released annually since 1997. There have been several hundred to over one thousand recoveries annually from the releases each year and a substantial database of recapture information now exists. In most years typically 5% to 7.8% of the initial releases are reported as recaptured in the year of release. In 1999, when the TAC was 30,000 t, over 10% of the releases in 1998 were reported as recaptured in the 1999 fishery. Although the 2001 fishery is still in progress, there have been many recaptures during 2001 from releases in preceding years; however, the number of recoveries from the 1997 and 1998 releases has decreased considerably.

## 6.1 Estimates of exploitation (harvest) rate

Brattey et al. (2001) used data from post-moratorium tagging experiments to estimate annual exploitation rates for cod tagged in various regions of 3Ps. The number of reported recaptures from individual cod tagging experiments gives minimum estimates of the exploitation rates on the aggregations of cod that were tagged. However, in practice, not all fish survive tagging, some tags fall off the fish particularly in the first year, and not all recaptures of tagged fish are reported. Tagged (and untagged) cod also suffer natural mortality due to factors such as predation and disease. Accounting for these losses leads to a reduction in the number of tagged (and untagged) animals available to the fishery. As in Brattey et al. (2001), information from companion studies was used to estimate these losses and produce more realistic annual estimates of exploitation. Double tagging was used to estimate tag loss rates and a high-reward tagging study was used to estimate reporting rates (Cadigan and Brattey 1999b); tagging mortality was estimated by retaining batches of tagged cod in submersible enclosures (Brattey and Cadigan 2001). Exploitation rates were estimated for cod tagged in a specific area at a specific time (i.e. individual tagging experiments), irrespective of where recaptures came from. In this analysis no attempt was made to estimate population sizes using tag returns and commercial catches, because typically some harvesting occurs in an area different from where fish were tagged. This makes it difficult to convert local catches to local population biomass in the absence of a model that accounts for fish movements (see Sections 6.2 and 6.3 below). Tag returns depend, in part, on the size selectivity of the fishery, requiring further refinements in the analysis (see Section 6.3 below).

Estimates of exploitation rate for cod tagged in Fortune Bay ranged from 0.11 to 0.22 and averaged around 0.15 (Brattey et al. 2001). In Placentia Bay (3Psc) individual estimates of exploitation ranged from 0.08 to 0.43. In 1997 and 1998, none of the individual estimates exceed 0.19, but in both 1999 and 2000 many estimates exceeded 0.30 and the overall averages for those years were 0.24 and 0.27 indicating extremely high exploitation of cod tagged in Placentia Bay. In the offshore, spatial coverage of tagging has been more limited and estimates of exploitation for cod tagged offshore have been much lower, ranging from 0.05 to 0.13 for cod tagged in the Burgeo Bank/Hermitage Channel area (3Psd), and 0.02 to 0.06 for cod tagged in Halibut Channel (3Psh).

## 6.2 Simple tagging model

Pope and Brattey (2001) developed a simple model for analysis of the post-moratorium cod tagging data that accounts for harvest within regions and migration between regions. This model also incorporates estimates of tagging mortality, tag loss and reporting rates, but not fishery selectivity. The methods described in Pope and Brattey (2001) were applied to all tagging data available up to the end of September 2001 and used to estimate local harvest rates and exploitable biomass in various regions of 3Ps (and inshore 3K and 3L). Estimates of harvest rate in 2000 for areas west of the Burin Peninsula and Placentia Bay of 7.4% and 45.2%, respectively, which corresponded to a combined exploitable biomass of 73,000 t. The estimate of exploitation for offshore areas of 3Ps in 2000 was 1.9%, which corresponded to an extremely high exploitable biomass for this offshore region; however, the reliability of the estimates for the offshore were considered questionable and implausibly high for the area of known distribution of cod and given the history of the fishery. Possible reasons for the high estimate are given below (see Section 6.3).

### 6.3 Detailed tagging model

Cadigan and Brattey (1999a, 2000a) developed a detailed model for analysis of the post-moratorium cod tagging data that accounts for tagging mortality (Brattey and Cadigan 2001), tag loss and reporting rates (Cadigan and Brattey 1999b), as well as growth (Cadigan and Brattey 2000b) and length selectivity of the commercial fishery. The most recent version of the model also accounts for migration between regions, and estimates weekly exploitation rates by region and cod length class (Cadigan and Brattey 2001, 2002). Exploitation rates are converted to exploitable population biomass using reported catches. Sampling of the length frequencies of commercial landings in each region, in conjunction with a length-weight relationship, were used to convert catch numbers to biomass. This model gave estimates of exploitable biomass for Placentia Bay (3Psc) and areas west of the Burin Peninsula (3Ps/a/b/d combined) of 70,000 t, which was similar to the estimate obtained from the simple tagging model (section 6.2). The estimate of exploitable biomass for the offshore was several hundred thousand metric tons; however, as stated in Section 6.2, the estimates for the offshore are considered to be unreliable. Possible reasons for the high estimates include the restricted distribution of tagging coverage and restricted distribution of fishing activity in the offshore, more uncertainty in the estimates of reporting rate from the offshore, and lower survival of fish caught for tagging offshore in deep water. These factors need to be explored further.

### 6.4 Stock structure and movements

Cod stock structure within the 3Ps management unit is complex (Lear 1984, 1988; Brattey 1996 and references therein) and results from recent tagging and genetics studies have been used to investigate stock structure and seasonal movement patterns of 3Ps cod during the post-moratorium period (Beacham et al. 1999, 2000; 2001 Brattey 1999, 2000; Brattey et al. 1999b, c, 2000; Ruzzante et al. 1998, 2000). Recaptures of tagged cod in 2001 and conclusions on stock structure from the most recent post-moratorium tagging experiments in 3Ps are described in Brattey et al (2002).

## 7. GEAC Stratified Random Trawl Survey

In 2000, the Groundfish Enterprise Allocation Council (GEAC) carried out a fourth consecutive fall bottom-trawl survey directed at cod with the intention of creating a series of annual fall surveys in 3Ps to complement current DFO RV surveys conducted in spring. DFO provides advice on the stratified random design and catch sampling. Results of the previous surveys are reported in McClintock (1999a, b) and for the most recent survey in McClintock (2000). These surveys are carried out in November and December and cover a large portion of offshore 3Ps but not the Burgeo Bank area (see McClintock 2000). The commercial trawler *M.V. Pennysmart* was used in all four surveys. Tows are of 30 min. duration using an Engels 96 high lift trawl with a 135 mm diamond mesh cod end (not lined). The trawl was fitted with rock-hopper foot-gear and Bergen #7 trawl doors. Performance of the trawl was checked onboard using Scanmar net sensors (Netmind in previous years): bridge display of door-spread, opening, and clearance were logged electronically. No wingspread sensor was used in the 2000 survey. The gear and configuration were identical in all four surveys. A total of 73 successful stratified random tow sets were completed in the 2000 survey. Two sets (# 12 and #33) were unsuccessful due to tears in the belly of the net.

The Scanmar net monitoring instruments were successfully deployed during the 2000 survey: door-spread exhibited values varying from 40 to 90 m depending on depth, mean door-spread and clearance values were similar to those in the 1999 survey, and the mean clearance in 2000 was 5.4 m compared with 4.0 m in 1999. An assumed wingspread value of 60 ft was used in the analysis. There were no indications of major changes in net performance during 2000 compared to previous years.

The mean cod catch per tow in 2000 was 45.3 fish with a mean catch weight of 225 kg; both values are substantially higher than those observed in the 1999 survey (16.5 fish per tow and 53.5 kg per tow, respectively). The largest catch of 3,071 cod weighing 17,083 kg was from set 45 in stratum 318 in the Halibut Channel at a depth of 220 m; this is the largest catch in any set since the survey started in 1997. A total of 12 sets had catches over 100 kg, and four sets had catches over 1,000 kg. The mean cod weight for all sets was 5.1 kg per cod, substantially larger than the mean for 1999 (3.7 kg).

Sets in the southern Halibut Channel and southeastern slopes of St. Pierre Bank had the highest catches in all surveys. The 1997 trawlable biomass index was 99,330 t whereas the 1998 and 1999 estimates for a larger survey area were 47,875 t and 44,521 t, respectively. The trawlable biomass index for 2000 was 187,229 t, over four times the estimate for 1999.

In terms of age composition, the 1997 survey catch was dominated by 5 year olds (1992 year class) and 8-9 year olds (1990 and 1989 year class). In the 1998 survey 9 year olds dominated (1989 year class) and next most abundant were 5 year olds (1994 year). In the 1999 survey, the 1989 and 1990 year classes are well represented along with the 1992, 1993, and 1994 year classes. In the 2000 survey, the 1989, 1990, and 1997 year classes are strongly represented. The 1991 year class is poorly represented relative to adjacent year classes in all three surveys.

Further information on the catches from the 2000 GEAC survey is given in McClintock (2000). For the first time there was a sufficient long time series in the GEAC survey to include the catch-rate-at-age information from this survey as an index in the sequential population analysis (see Section 9).

## 8. Research vessel survey

Stratified-random surveys have been conducted in the offshore areas of Subdiv. 3Ps during the winter-spring period by Canada since 1972, and by France for the period 1978-92. The two surveys were similar with regard to the stratification scheme used, sampling methods and analysis, but differed in the type of fishing gear and the daily timing of trawls (daylight hours only for French surveys). Canadian surveys were conducted using the research vessels *A.T. Cameron* (1972-82), *Alfred Needler* (1983-84), and *Wilfred Templeman* (1985-2001). From the limited amount of comparable fishing data available, it has been concluded that the three vessels had similar fishing power and no adjustments were necessary to achieve comparable catchability factors, even though the *A.T. Cameron* was a side trawler. The French surveys were conducted using the research vessels *Cyros* (1978-91) and *Thalassa* (1992) and the results are summarized in Bishop et al. (1994).

The stratification scheme used in the DFO RV bottom-trawl survey in 3Ps is shown in Fig 11. Canadian surveys have covered strata in depth ranges to 300 ftm since 1980. Five new inshore strata were added to the survey from 1994 (779-783) and a further eight inshore strata were added from 1997 (293-300). For surveys from 1983 to 1995, the Engel 145 high-rise bottom trawl was used. The trawl catches for these years were converted to Campelen 1800 shrimp trawl-equivalent catches using a length-based conversion formulation derived from comparative fishing experiments (Warren 1997; Warren et al. 1997; Stansbury 1996, 1997).

The Canadian survey results (in Campelen-equivalent units, see below) are summarized by stratum (Fig. 11) in terms of numbers (abundance) and biomass in Tables 9 and 10, respectively, for the period 1983 to 2001. Strata for which no samples are available were filled in using a multiplicative model. Timing of the survey has varied considerably over the period. In 1983 and 1984 the mean date of sampling was in April, in 1985 to 1987 it was in March, from 1988 to 1992 it was in February. Both a February and an April survey were carried out in 1993; subsequently, the survey has been carried out in April. The change to April was aimed at reducing the possibility that cod from adjacent northern Gulf (3Pn4RS) would erroneously be counted as part of the 3Ps stock.. A portion of the Northern Gulf cod stock may cross the stock boundary into the Burgeo Bank area (see Fig. 1) and mix with 3Ps cod in winter in some years, mixing with the 3Ps stock and migrating back into the Gulf some time during the following spring. Campana et al. (1998, 1999, 2000) has suggested that the mixing may be substantial in some years and recent tagging studies suggest that mixing may extend into April in some years (see Figs. 14 and 15; also Brattey et al. 1999b, 2002); however, the extent, timing, and duration of mixing are variable and have not been quantified on an annual basis.

## 8.1 Abundance, biomass, and distribution

In the 2001 survey (see Tables 9, 10) there were six strata with high abundance and biomass estimates, including two strata located southwest of Burgeo Bank (714, 715), two strata on Burgeo Bank (307, 309), and two strata on the NW corner of St. Pierre Bank (311, 313). The stratum with the largest catch was 319 located in the Halibut Channel; this stratum accounted for 59.3% of the biomass index and 66.5% of the abundance index for the stock area.

Trends in abundance and biomass from the RV survey of the index strata in 3Ps (depths less than or equal to 300 ftm, excluding the new inshore strata) are shown Fig. 12. The abundance and biomass time series from 1983 to 1999 shows considerable variability, with strong year effects in the data. Both abundance and biomass are low after 1991 with the exception of 1995, 1998, and 2001. The 1995 estimate is influenced by a single enormous catch contributing 87% of the biomass index and therefore has a very large standard deviation. The 1997 Canadian index was the lowest observed in the time series, which goes back to 1983, being less than half of the 1996 index. The size composition of fish in the 1997 RV survey suggested that this survey did not encounter aggregations of older fish, yet these fish were present in the 1996 survey and in commercial and sentinel catches in subsequent years. The minimum trawlable biomass from the 2000 survey was 46,111 t, compared to 86,991 t from the 2001 survey. Abundance in 2000 was 46.5 million versus 88.2 million in 2001.

The survey data are also expressed in terms of catch rates (i.e. mean numbers per tow) for the eastern and western portions of the stock area separately (Fig. 13). The trend for the eastern portion of the stock area is similar to that for the abundance and biomass indices for the stock area as a whole. Catch rates for the eastern portion show considerable variability, with strong year effects but are generally higher in the 1980's, low after 1991, except in 2001. The 1995 estimate is influenced by a single large catch taken at the bottom of Halibut Channel. The catch rates for the western (Burgeo) portion, which has been surveyed in April since 1993, are extremely variable, but are generally higher than those for the eastern region. The value for 1998 is extremely high due to several large catches on Burgeo Bank and vicinity that may have included fish from the neighbouring northern Gulf cod stock.

Cod appear to have become scarce or absent in shallow strata on St. Pierre Bank in the 1990's (Tables 9 and 10, Fig. 14). Abundance during the early to mid-1990's was highest in the southern Halibut Channel area towards the edge of the survey area, and on the slopes in the vicinity of Burgeo Bank and the Hermitage Channel. However, there is also some indication that cod were becoming more widespread over the survey area during 1997-2000 compared to the early 1990's, albeit at low abundance (Fig. 14). In the April 2001 survey, cod were less widely distributed across the top of St. Pierre Bank compared to 1999 and 2000 (Tables 9 and 10; Figs. 14 and 15). This change in distribution correlates well with the return to cooler temperatures in 2001 (see below). As in previous years, largest catches were localized in the southern Halibut Channel, Fortune Bay, on the northwest corner of St. Pierre Bank, and in the Burgeo Bank-Hermitage Channel area.

An analysis of near-bottom temperatures in 3Ps during winter and spring surveys are presented in Colbourne and Murphy, (2002) in relation to the spatial distributions and abundance of cod for the years 1983 to 2001. Interannual variations in the near-bottom thermal habitat were examined by calculating the areal extent of the bottom covered with water in 1°C temperature bins. The analysis revealed a significant shift in the thermal habitat in the region with the areal extent of subzero °C bottom water covering the banks increasing dramatically from the mid-1980s to the mid-1990s. During this time period zero catch rates dominated on St Pierre Bank and in the eastern regions of 3Ps. Beginning in 1996 the area of 0°C water on the banks decreased significantly reaching very low values in 1998 and a complete disappearance in 1999 and 2000. The areal extent of bottom water with temperatures >1°C on the banks was about 50% of the total area during 1998 the first significant amount since 1984 and it increased further to about 70% during 1999 and to 85% during 2000. During 1999 and 2000 larger catches of cod became more wide spread over St. Pierre Bank region as the cold sub-zero °C water disappeared from the area. There were many zero catches in the eastern areas during 2001 as colder water returned to that region. During all surveys most of the larger catches occurred in the warmer waters (>2-3°C) along the slopes of St. Pierre Bank and areas to the west of St. Pierre Bank. An examination of the cumulative distributions of temperature and catch indicates that cod are associated with the warmer portion of the available temperature distribution, with a slightly warmer preference based on weight than numbers (implying a greater degree of habitat selection by larger fish).

## 8.2 Age composition

Survey numbers at age are obtained by applying an age-length key to the numbers of fish at length in the samples. The current sampling instructions for Subdiv. 3Ps require that an attempt be made to obtain 2 otoliths per one cm length class from each of the following locations – Northwest St. Pierre Bank (strata 310-314, 705, 713), Burgeo Bank (strata 306-309, 714-716), Green Bank-Halibut Channel (strata 318-319, 325-326, 707-710), Placentia Bay (strata 779-783) and remaining area (strata 315-317, 320-324, 706, 711-712). This is done to spread the sampling over the survey area. The otoliths are then combined into a single age-length key and applied to the survey data. The resulting estimates of mean numbers per tow are given in Table 11. It is in this form that the data are used in the calibration of sequential population analysis models. These data can be transformed into trawlable population at age by multiplying the mean numbers per tow at age by the number of trawlable units in the survey area. This is obtained by dividing the area of the survey by the number of trawlable units. For 3Ps, the survey area is 16,732 square nautical miles including only strata out to 300 ftms and excluding the relatively recent strata created in Placentia Bay. The swept area for a standard 15 min tow of the Campelen net is 0.00727 square nautical miles. Thus, the number of trawlable units in the 3Ps survey is 16,732/0.00727=2.3x106.

The mean numbers per tow at age in the research bottom-trawl survey is given in Table 11. The most numerous ages in the 2001 survey were 3 and 4 (1997 and 1998 year-classes). Among older ages, the 1989 year-class is also well represented. However, survey catches over the post-moratorium period have consistently shown few survivors from year-classes prior to 1989. Indications from the 2000 and 2001 surveys are that the 1997 and 1998 year classes are stronger given that catch rates at ages 3 and 4 are much higher. These ages classes were also well distributed across the stock area in the 2001 survey and also appear strong in the GEAC survey and in the sentinel line-trawl catches in 2000. The 1999 year class also appears reasonably strong in the 2001 survey, although data for this year class are still too limited for firm conclusions to be drawn. Overall, the low 1997 survey results appear anomalous given that three year classes (1989, 1990 and 1992) that have been well represented in the post-moratorium fishery, the 1998-2001 DFO surveys, and the fall industry (GEAC) surveys, did not appear to be encountered in the 1997 survey. Although the 1990 and 1989 year classes are still reasonably well represented and have reached ages 11 and 12, respectively, these are among the oldest fish encountered in the survey. The age composition is improving, but remains somewhat contracted relative to the mid-1980's when cod aged 12-20 were consistently encountered in surveys of 3Ps (see Table 11).

The spatial distribution of catches of cod aged 2, 3, 4, and 5 during the 2001 survey was examined (Fig. 16). Age 2's were mostly located in the central portion of the stock area and in shallower water on top of St. Pierre Bank. Age 3 and age 4 cod were widely distributed on Burgeo Bank, St. Pierre Bank, in Fortune Bay, and in Halibut Channel, whereas age 5 cod were mainly located in Fortune Bay, Burgeo Bank, and Halibut Channel.

## 8.3 Size-at-age (mean length and mean weight)

The sampling protocol for obtaining lengths-at-age (1972-2001) and weights-at-age (1978-2001) has varied over time (Lilly 1998), but has consistently involved stratified sampling by length. For this reason, calculation of mean lengths and weights included weighting observations by population abundance at length (Morgan and Hoenig 1997), where the abundance at length (3-cm size groups) was calculated by areal expansion of the stratified arithmetic mean catch at length per tow (Smith and Somerton 1981).

Mean lengths-at-age (Table 12; Fig. 17) varied over time. There are strong year effects that have not yet been explained (Lilly 1998). For the period 1972-2001, peak length-at-age occurred in the mid-1970s for young ages (3-4) and progressively later to 1980 for older ages. From the mid-1980s to the present, length-at-age tended to increase at young ages (2-3) and to vary with no clear trend at older ages. There is some indication of a slight increase in length-at-age among older ages in the late 1990's.

An exploration of the potential effects of environmental factors such as temperature has not been conducted, because there appears to be negative growth for at least 2 cohorts during each of the intervals 1977-1978, 1980-1981, 1989-1990 and 1993-1994 (Lilly 1998). Further analyses are required to test whether differences in length-at-age exist among the various groups of fish occurring in Subdivision 3Ps at the time of the surveys, and to determine whether annual variability in the rate at which these groups were sampled might explain some of the year effects in length-at-age.

Estimated length increments for the 1989 year-class have been very large (12 cm) in the period 1997-1998. Growth has continued to be strong during 1998-2001. As noted previously (Lilly 1996; Chen and Mello 1999a, b), the year-classes born in the 1980s experienced slower growth than those born in the 1970s. Length-at-age of the 1989 year-class was similar to the average of the 1982-1986 year-classes up to age 8, but by ages 9 and 10 the 1989 year-class had surpassed the average of the 1975-1979 year-classes (Fig. 18).

As expected, the patterns in mean weight-at-age (Table 13; Fig. 19) appear to be very similar to those in length-at-age. However, the weight-at-age data may include more sampling variability because they are based on smaller sample sizes (Lilly 1998). The weight-at-age data also include variability associated with among-year and within-year variability in weight at length (condition).

## 8.4 Condition

The somatic condition and liver index of each fish were expressed using Fulton's condition factor $((W/L^3)*100)$, where W is gutted weight (kg) or liver weight (kg) and L is length (cm). Condition and liver index at age were calculated as described above for size-at-age.

Mean somatic (gutted) condition at age (Table 14; Fig. 20A) was variable from 1978 to 1986, relatively constant from 1986 to 1992, and dropped suddenly in 1993 before rising to an intermediate level in 1995-2001. Comparison of post-1992 condition with that observed during 1985-92 is difficult because survey timing has changed. Condition varies seasonally and tends to decline during winter and early spring. Nonetheless, condition of cod in the 1995-2001 surveys appear to be normal.

Because length-at-age has changed over time (see above) and condition calculated with Fulton's formula usually increases with body length, condition at length (Fig. 20B) might be more appropriate than condition at age as an indicator of changes in condition over time. As demonstrated by Lilly (1996), much of the annual variability is related to the timing of the surveys. When mean condition in each of three length groups was plotted against the median date of sampling during the survey (Fig. 20C), there was a gradual decline in condition from the earliest median date (Feb. 7) to approximately late April, after which there was an increase. The time course of changes from late April onward is poorly defined because of the paucity of observations. A decline in condition during the winter and early spring was also observed in cod sampled from sentinel survey catches in the inshore in 1995 (Lilly 1996).

Mean liver index at age (Table 15; Fig. 21A) had a pattern similar to that seen in condition, except that the 1983 values were more clearly at higher levels than other years in the early 1980s and there was a more pronounced peak in the late 1980s and early 1990s. When the values for specific size groups (Fig. 21B) were plotted against the median date of sampling (Fig. 21C), there was a very pronounced decline in liver index during winter and early spring.

From the above, it is clear that the low condition and liver index in recent years (1993-2001) are interpreted to be mainly a consequence of sampling near the low point of the annual cycle and not to be indicative of a large and persistent decline in well-being. If attention is focused on those surveys conducted during years when the mid-date of sampling was during the period April 13-26, then it appears that condition improved from 1993-1994 to 1996-1998 and has declined somewhat in the most recent years (Fig. 20A, B). Mello and Rose (2001) described seasonal changes in condition and liver index of cod in Placentia Bay and their findings generally agree with those described above.

Condition of cod is an important characteristic of the stock, particularly in terms of recruitment, because fish in poor condition are thought to spawn less successfully than those in good condition (Burton and Idler 1984; Kjesbu et al. 1991; Marshall et al. 1998; Marteinsdottir and Steinarsson 1998). No formal analysis of the relationship between condition and recruitment has been conducted for 3Ps cod, partly because it is difficult to estimate yearly average condition when long-term data are only available from surveys conducted in winter/spring. Survey timing has also changed. Nonetheless, the increasing trend in condition observed during 1993-1998 (Figs 20A, 20B, 21A, 21B) agrees well with the estimated recruitment for the corresponding time period (see Fig. 25 below).

## 8.5 Maturity and spawning

The gonads of samples of cod collected during annual DFO winter/spring bottom-trawl surveys were visually inspected and assigned to the category "immature" or "mature" according to the criteria of Templeman (1978). Mature fish were further classified as maturing, spawning, or spent (see Morgan and Brattey 1996). Visual inspection is not always totally accurate and there can be difficulties in classifying some stages; for example, mature fish that are skipping a spawning year may be erroneously classified as immature or vice-versa, and mature fish that have recently shed a batch of hydrated eggs may be classified as maturing when they are in fact spawning. The extent to which these errors influence the estimation of proportion mature and proportion at each stage of maturation has not been fully evaluated. However, Bolon and Schneider (1999) showed using histological methods that the visual method of classification was reasonably accurate, but tended to slightly underestimate the proportion of spawning fish and overestimate the proportion of maturing fish when spawning was occurring in Placentia Bay.

Annual estimates of age at 50% maturity ($A_{50}$) for females from the 3Ps cod stock, collected during annual winter/spring DFO RV surveys, were calculated as described by Morgan and Hoenig (1997). Maturation in the current assessment was, however, re-evaluated and is estimated by cohort rather than by year as in previous assessments. In addition, data extending back to 1954 has been included in the current analyses. The estimated age at 50% maturity ($A_{50}$) was generally between 6.0 and 7.0 from the mid-1950s to the early 1980s, but declined dramatically thereafter to a low of 5.1 during 1988 (Table 16, Fig. 22). Age at maturity by cohort remained low but fairly constant during 1988 to 1994; estimates for the 1995 and 1996 cohorts are somewhat higher, but are estimated with more uncertainty because only a small number of younger ages from these cohorts are available to estimate $A_{50}$. Males show a similar trend over time (data not shown), but tend to mature about one year earlier than females. The annual estimates of proportion mature for ages 3-8 show a similar increasing trend (i.e. increasing proportions of mature fish at young ages) through the late 1970s and 1980s, particularly for ages 5, 6, and 7 (Fig. 23). The overall age at maturity remains low among 3Ps cod and this has a substantial effect on the estimates of spawner biomass for this stock. In addition, the age composition of the spawning biomass may have important consequences in terms of producing recruits. A spawning stock biomass that consists mainly of older fish, or a broad age range, may result in a longer time span of spawning (Hutchings and Myers 1993; Trippel and Morgan 1994). Older, larger fish also produce more viable eggs and larvae (Solemdal et al. 1995; Kjesbu et al. 1996; Trippel 1998). Several characteristics of the spawning stock biomass (SSB) of 3Ps cod (and other NF fish stocks) were explored for variability and for relationships with the residuals from Beverton-Holt stock-recruit models (Morgan et al. 2000). Weighted mean age of the SSB, proportion of first time spawners, and proportion female all showed substantial variability over time, but the results were not consistent among the stocks examined and were difficult to interpret.

The time series of maturities for 3Ps cod shows a long-term trend as well as considerable annual variability, but is reasonably stable in the last several years. To project the maturities for 3Ps cod forward to 2010, for each age group we used the average of the last three estimates for the same age group (Table 17). To fill in missing age groups in the early part of the time series we used the average of the first three estimates for the same age. These values were used for projections of mature spawner biomass in the evaluation of TAC options.

Maturities of adult female cod sampled in three sub-areas of NAFO subdivision 3Ps during winter/spring RV bottom-trawl surveys from 1983-2001 are shown in Fig. 24. Note that immature fish are excluded from this analysis. The areas are defined as Burgeo Bank / Hermitage Channel (Strata 306-310 and 714-716), Southern 3Ps / Halibut Channel (all areas south of 45°34.5' N), and mid-3Ps which includes the remainder of the subdivision (excluding inshore strata 293-300 and 779-783). The timing of the survey varied through the time series, with surveys predominantly in April during 1983-84, March during 1985-1987, February from 1988-1992, and April from 1993 to 2001. There were two surveys (February and April) in 1993; only the April one is shown here. The three sub-areas show a consistent pattern of maturity stages across most of the time series, with maturing fish dominating in most years. The switch in timing from February to April clearly results in an increase in the proportions of spawning fish and a reduction or disappearance of fish that are spent from the previous year. When surveys were conducted in April, spawning and spent fish were found in each area; within any one year the proportion of spawning and spent fish tended to vary among sub-areas, but generally about 15-50% of the mature fish sampled were spawning or recently spent. The results from the 2001 survey show no dramatic changes from recent years. The March 1987 sample from the most southerly area appears anomalous, with an unusually high proportion of spawning fish compared to other areas in 1987 and compared to adjacent years within the same area. The results also show that a substantial proportion (typically 20-30%) of the mature female cod sampled in the Burgeo area in the April surveys are spawning and therefore, by definition, belong to the 3Ps stock; most of the remaining adult females are maturing to spawn later in the same year and their stock affinities remain unclear.

Overall, cod in 3Ps appear to spawn over a significant portion of the year and at many locations within the stock area, and there appears to be no consistent peak in the spawning time. Spawning is spatially widespread and is known to occur on Burgeo Bank, St. Pierre Bank, and the Halibut Channel area, as well as inshore in Hermitage Bay (3Psa) Fortune Bay (3Psb) and Placentia Bay (3Psc). Spawning in Placentia Bay in recent years has been studied more intensively (Bolon and Schneider 1999; Lawson and Rose 1999; Bradbury et al. 2000; Mello and Rose 2001).

## 9. Year Class Strength Model

A multiplicative model was used to estimate the relative year class strength produced by the spawning stock, based upon catch rate data for ages 1-4 inclusive from the following indices: DFO RV for Burgeo area (1993-2001), DFO RV survey without Burgeo area (1983-2001), DFO survey using *A.T. Cameron* (1972-1982), sentinel gillnet and line-trawl (1995-2000), GEAC (1997-2000), and acoustic estimates (1996-2001). Similar approaches have been implemented by Healey et al. (2001) for Greenland Halibut in NAFO Divs. 2GHJ3KLMNO, and by Morgan et al. (2001) for American Plaice in NAFO Div. 3LNO. On a log-scale the model can be written as follows:

$$\log(I_{s,a,y}) = \mu + Y_y + (SA)_{s,a} + \varepsilon_{s,a,y},$$

where:

$\mu$ = overall mean
$s$ = survey subscript
$a$ = age subscript
$y$ = year class subscript
$I$ = index (abundance in 000's)
$Y$ = year class effect
$SA$ = survey * age effect, and
$\varepsilon$ = error term.

It was assumed that $\varepsilon_{s,a,y} \sim N(0,\sigma^2_{SA})$, independently and identically; that is, each survey-age combination has a different variance. Index values of zero were replaced by 5% of the non-zero minimum from the appropriate index. Estimates (Fig. 25) are back-transformed. Estimates of year class strength for the 1970-1988 year classes are based on one (offshore) survey only; all subsequent year classes have been measured by multiple indices (including the inshore sentinel survey since 1995). Furthermore, estimates for the most recent year classes (e.g. 1998 and 1999) are based on a few measurements and have high uncertainty.

Estimates of year class strength indicate that all cohorts in the late 1980's were substantially stronger than the estimates for the 1990-1996 year classes; however, the 1997 year class appears stronger and the 1998 and 1999 year classes are the strongest in the recent period.

## 10. Sequential Population Analysis

### 10.1 Analyses carried out in the 2000 assessment

A total of 18 QLSPA formulations were evaluated in the 2000 assessment of this stock. The large number of runs was partly a consequence of the issue of possible mixing between 3Ps and northern Gulf cod stocks in the western portion of the stock area. Runs were also carried out to examine the effects of different partial recruitment vectors, the influence specific survey index, and the effect of including or excluding various calibration indices. A final model was selected and risk analysis was carried out on this model and one alternative model. The final model was calibrated with the Cameron index, a split winter-spring Templeman index (eastern and western portions treated as separate indices), and Sentinel gillnet and line-trawl indices. An alternative QLSPA model was fit which excluded the Burgeo Bank catch and the Burgeo Bank survey strata (i.e. a mode for only the eastern portion of the stock area). This run was done to illustrate the possible outcome in terms of risk associated with various TAC options if the western portion of 3Ps were closed to fishing and effort redirected to the eastern portion, under the assumption that the western portion contained predominantly northern Gulf cod (a situation that is not thought to hold, so that this model represents a "worst case scenario").

## 10.2 Description of SPA runs for the current assessment

In the 2002 assessment, initial diagnostic analyses were carried out to examine quality and coherency of the catch at age and tuning indices prior to running any SPAs. This was followed by a number of sensitivity runs using ADAPT, QLSPA and XSA to examine the effect of alternative models and formulations. For comparison purposes, the identical model/formulation used for providing scientific advice in the 2000 assessment was also applied to the data. Finally, a set of 5 models/formulations, including the 2000 model/formulation, were adopted as a basis for presenting a table of risk associated with alternative quota options for 2002/03 with respect to several biological reference points.

### *Diagnostic analyses*

Diagnostic analyses consisted of analysis of variation in the data and diagnostic SPA runs. The following data were considered in the diagnostic analyses:

| | | |
|---|---|---|
| Commercial catch at age | 1959 – 2001 | ages 2 – 14 |
| RV_survey (not split) | 1983 – 2001 | ages 1 – 14 |
| RV survey (eastern portion) | 1983 – 2001 | ages 1 – 14 |
| RV survey (western portion) | 1993 – 2001 | ages 1 – 14 |
| Sentinel Gill net survey | 1995 – 2000 | ages 3 – 10 |
| Sentinel line trawl survey | 1995 – 2000 | ages 3 – 10 |
| Cameron survey | 1972 – 1982 | ages 1 – 14 |
| GEAC survey | 1997 – 2000 | ages 1 – 14 |
| Acoustic survey in Placentia Bay (Rose) | 1996 – 2001 | ages 2 – 12. |

Analysis of variance (ANOVA) was used to examine age, year and year-class effects in these data using the multiplicative model approach of Shepherd and Nicholson (1991). Much of the variance in the logarithm of catch-at-age data can be explained by a simple multiplicative model with 3 factors representing ages, years and year classes. In this approach, the catch at age or tuning index at age value is considered to be a product of an age effect (a combination of selectivity or catchability and cumulative total mortality) and a year class effect (to account for the varying strengths of year-classes). This model is applied by fitting age, year-class and year factors to the logarithmic transformation of the catch or tuning index at age data. Fitting was carried out using PROC GLM in SAS. We first fitted each effect by itself to determine how much of the variation could be explained by each effect alone. We then examined Type I SS for age, year class and year, which is the improvement in the error SS when each effect is added sequentially to the model. Lastly, we examined the Type III SS, which is the improvement in the error SS when the effect is added to the model after all other effects have already been taken into account. The results are presented in Tables 18-20

The ANOVAs examining each effect by itself (Table 18) showed that in all cases the age effect explains most of the variation (60-83%). This is in keeping with the anticipated effects of selectivity and cumulative mortality. In all cases, with the exception of the catch data, year class was next in terms of the amount of variation explained. However the amount of variation explained by year class was not significant at the $\alpha = 0.05$ level in the case of sentinel line-trawl data. A strong year class effect in the indices is desirable because it indicates that year classes are being tracked, despite measurement error and variation in mortality and catchability or selectivity at age. In the case of the commercial catch data, the year-class effect was not significant and explained less of the variation than the year effect. The strong year effect in the catch data is mostly a consequence of the strong signal imposed on the data by the changes in TAC that have taken place. Significant year effects in the tuning indices are not desirable and can arise through changes in survey catchability from year to year or a trend over time. Significant year effects were apparent in the Templeman RV survey data (not split), the eastern portion of the survey data and the GEAC survey data. The root mean square error (root MSE) provides a measure of the residual variance unexplained by the model. Values ranged from about 0.8 to 2.2.

An examination of Type I SS (Table 19) showed that age, year class and year effects together generally explain between 86% and 99% of the amount of variation in the data.
The year class effect in the acoustic data was not significant after the age effect in the data has been accounted for. In all other data year class effects were significant. An examination of the Type III SS (Table 20) also shows that year class was not significant for the acoustic survey index when it enters last into the model. Year class effects were smaller than the year effects for the RV survey indices when year class enters last into the model. The largest root MSE occurred in the acoustic data, indicating considerable residual unexplained variability once age, year class and year effects had been removed. Values were also high for the eastern portion of the RV survey, the Cameron survey and the GEAC survey. Large values suggests a lot of noise in these tuning indices (e.g. age*year interaction, age*year class interaction or year*year class interaction).

Diagnostic SPA's including only one index at a time are useful for comparing the agreement between the index and the information contained in the catch. Analyses carried out using XSA and ADAPT showed substantial year effects in the RV survey (both as a single survey and as split surveys) but no overall pattern in the residuals. In contrast there was a strong residual pattern in the sentinel gillnet data, with data for the more recent period being over-predicted. A "U" shaped pattern was observed in the residuals from the GEAC survey but this was not considered to be as undesirable as the trend observed in the sentinel gillnet data. With respect to the RV survey index, the split surveys were considered to be more problematic with respect to residual patterns in the XSA diagnostic runs than the combined data. It was considered undesirable to include the sentinel gillnet index in further SPA runs (except for a comparison run using the same model/formulation as the 2000 assessment). It was also considered useful to carry out runs using both the split and non-split RV index.

In addition to the diagnostic SPA runs, an analysis of the sum of products for the catch at age data using mean weights at age compared to the total annual landings indicated substantial problems in the data for the period prior to 1977. It was decided advisable to omit these data in all SPA runs except for the comparison run using the same model/formulation as the last assessment. The problem needs to be rectified because historic catch at age data are important in determining spawner biomass and fishing mortality reference levels under the precautionary approach which has been adopted by DFO.

*Sensitivity runs*

Various SPA models (XSA, ADAPT, QLSPA) and a variety of formulations of these models were applied to the data to examine the sensitivity of the assessment to the method used. Formulations that were examined included self-weighting of the indices (inverse variance), as opposed to equal weighting, various partial recruitment assumptions on the oldest age in the model (age 14) and the splitting versus non-splitting of the RV survey into eastern and western portions (splitting is an attempt to account for the purported mixing of northern Gulf cod into Burgeo Bank portion of the stock area at the time of the survey).

The sensitivity runs demonstrated that there is considerable uncertainty about the absolute size of 3Ps cod stock in the current assessment. Spawner biomass estimates for the beginning of 2001 ranged from about 40,000 t to 160,000 t (Fig. 26). Despite the absolute difference in magnitude, the relative trends in spawner biomass were robust, being very similar in all the runs carried out with the current data. The current perception regarding relative trends is that the spawner biomass increased from 1994 to 1999 but has subsequently been declining. In general, the sensitivity runs incorporated only catch data from 1977 onwards and used all available tuning indices with the exception of the acoustic index and the sentinel gillnet index (some XSA runs included gillnets), in keeping with the results from the diagnostic analyses.

Recent assessments of this stock have been based on QLSPA formulations and these are shown in bold and are labeled in Fig. 26. Also included is a "comparison run" (October 2001) which applies the identical formulation to that used in the last assessment (October 2000) but includes the additional year of data for the catch and tuning indices. Estimates from these formulations fall in the middle region of the range of estimates for the recent period from all models/formulations examined in the sensitivity runs in this assessment. In the current assessment, 4 of the sensitivity runs gave higher estimates than those runs adopted in recent assessments. These are all QLSPA formulations and they are the 4 highest runs shown in Fig. 26. The highest of these estimates came from a QLSPA formulation that included self-weighting, no split in the RV index and shrinkage in the estimate of *F* on age 14. Shrinkage was achieved by penalising candidate estimates based on the degree of departure from a ratio of 0.5 between the *F* on age 14 and the average *F* on ages 11-13, so that the fit function was equal to the deviance plus a penalty. In the other 3 runs the RV was split into eastern and western portions, self-weighting was applied and, variously, *F* on age 14 was treated as a free parameter, shrunk toward 0.5 and shrunk toward 1.0, giving consecutively lower estimates, but all higher than those used as the basis for scientific advice in recent assessments.

Three QLSPA formulations gave estimates that were closer to the recent assessments. These were, in decreasing magnitude of the estimates for the recent period, a formulation with *F* shrinkage on age 14 toward a ratio of 0.5; no split in the RV index and equal weighing applied; a similar formulation but with the survey split; and a formulation with *F* on age 14 fixed at a ratio of 0.5, the survey split and self-weighting applied.

A group of models/formulations gave estimates that were substantially lower than those used as the basis for scientific advice in recent assessments. These comprised 7 XSA formulations and 2 ADAPT formulations. The XSA formulations included runs with the RV survey split and not split, with self weighting and equal weighing, and with estimates of oldest age survivors (age 14) for the years 1977 to 1993 shrunk towards 0.5* the mean *F* of ages 11 - 13 (0.4 was used in some runs). It should be noted that in XSA the self-weighting was applied by fleet*age rather than by fleet as in QLSPA and includes an inverse exponential cumulative fishing mortality factor that downweights the influence of cohort survivor estimates given at younger ages (Darby and Flatman, 1994). This weighting factor in XSA results in different weights being given to the tuning fleets estimates of survivors if they don't have the same age range. The option of turning off this weighting is not implemented in the software and therefore a complete equal weighting option could not be tested.. Two ADAPT runs were included in the sensitivity analysis. In the first run *F* on age 14 was fixed to equal to 0.5* average *F* on ages 11-13, with the exception of years 1993-2000 for which survivors at age 14 were estimated, the RV survey was not split, and equal weighting was applied. In the second run the same formulation was used with the only difference being that the RV survey was split into eastern and western portions.

Whether or not the tuning indices were self-weighted had a major impact on the QLSPA estimates. In the formulations with the *F* ratio shrunk toward 0.5 and with the RV index not split, the self-weighted SSB estimates were substantially higher than the unweighted estimates over the time period, with estimates in the final year differing by more than 40,000 t. A similar comparison with the RV index split into eastern and western series gave estimates that were more similar, however the self-weighted estimates were again higher throughout the time period, but differing only by about 16,000 t in the final year. In the case of XSA, self-weighting had very little effect on the estimates of SSB irrespective of whether or not the RV survey was split, although estimates from self-weighting tended to be a little lower compared with estimates from equal weighted XSA fits to the data. It should be borne in mind that self-weighting is implemented differently in QLSPA and XSA.

Assumptions regarding the fishing mortality on the oldest age in the SPA was shown to have a major effect in the sensitivity analysis. Four QLSPA formulations (self-weighted, split RV survey) which differed only in the treatment of the *F* on the oldest age were compared (Fig. 27). In the first run *F* on the oldest age was treated as a free parameter, in the second run the ratio of *F* at age 14 to the average *F* on ages 11-13 was shrunk towards a ratio of 0.5, in the third run the *F* ratio was shrunk towards 1.0 and in the fourth run the *F* ratio was fixed at 0.5. These analyses showed considerable variation between formulations in the magnitude of the stock over the time period as well as some variation in the trajectory. The run with *F* as a free parameter resulted in the highest estimates of SSB and with a post-moratorium peak in SSB which was substantially less than the one that occurred in the mid-1980s. The run with the *F* ratio shrunk towards 0.5 gave similar but slightly lower estimates. The run with the *F* ratio shrunk towards 1.0 gave estimates that were lower again, and with pre and post moratorium peaks in SSB which were of similar magnitude. The run with the F ratio fixed at 0.5 have the lowest estimates; they also exhibit a post moratorium peak in SSB which was higher than the pre moratorium peak.

The effect of splitting of the RV survey to account for the purported mixing of northern Gulf cod into the 3Ps stock area in winter was evaluated using all three model approaches. The effect of splitting appeared to be greatest in the case of ADAPT (in which indices are equal weighted and for which no shrinkage in the *F* ratio was applied). SSB estimates from the split run were substantially higher. In QLSPA (*F* shrunk towards 0.5) the differences were smaller and split estimates were lower when either self-weighting or equal weighting was applied. In XSA the differences were also small and the split estimates were lower whether or not self-weighting was applied.

*Selected runs for projections and risk analysis*

It was considered that, while the actual size of the stock over time was uncertain, the consistency in the trends among methods would imply that inferences regarding risk may be relatively robust. Consequently, 5 model/formulation runs were selected on the basis of providing plausible representations of the stock consistent with the available data and acceptable fits under commonly applied statistical criteria for evaluating SPA output in stock assessments. These models were applied to the catch data from 1977 onwards and included the RV index (split and non-split), Cameron index, Sentinel line-trawl index and the GEAC index. More detailed information is provided on one of these runs – the identical model/formulation used in the 2001 assessment for providing scientific advice, but with the addition of an extra year of data. This run was called the "comparison run".

The five model/formulations comprised:

A) QLSPA run with the identical formulation to the final model (Run 10) in the 2000 stock assessment (Brattey et al. 2000), updated with an additional year of data for the catch and tuning indices (includes catch from 1959 onwards and the sentinel gillnet index). This run is termed the "comparison run". In this formulation the RV is split into eastern and western portions, self-weighting is applied and the ratio of *F* at age 14 to the average *F* on ages 11-13 was estimated, but constrained to be equal in all years between 1959 and 1993. The *F* ratio was estimated independently for each year between 1998 and 2001, and for ages10-13 in 1993 (each ratio being based on the average of the preceding three ages) on account of the moratorium.

B) QLSPA run with the catch at age from 1977 onwards, same tuning indices as in A (split RV) except with the sentinel gillnet index dropped from the calibration, self-weighting of the indices, and the *F* ratio at age 14 estimated independently for each year from 1977-93 and 1998-2001, but with estimates shrunk towards 0.5 (fit function equal to the deviance plus a penalty term), *F* ratio in 1993 estimated (with no shrinkage) for ages 10-13 (in each case based on the ratio to the average F in the previous three ages)

C) XSA was run on the same catch at age and tuning indices as B, with survey catchability *q* on age 14 constrained to be equal to age 13, with *F* on age 14 constrained to be equal to 0.4*average *F* on ages 11-13 for 1977-92, and inverse variance weighting of each fleet's estimates of survivors limited to a minimum standard error threshold of 0.5. This limitation is implemented in order to reduce possible influence of fleets with low catchability standard errors at certain ages due to use of too few data points.

D) ADAPT using the same catch and tuning indices as B except the RV index was not split, survivors at age 14 for years 1993-2001 and ages 2-13 in 2001 estimated, *F* on age 14 constrained to be equal to half average *F* on ages 11-13 in each year for 1977-1992.

E) ADAPT using the same catch and tuning indices as B, estimated survivors at age 13 for years 1993-2001 and ages 2-12 in 2001, *F* on age 14 constrained to be equal to half the average *F* on ages 11-13 in each year for 1977-1992.

Detailed information on model fit statistics and estimates are only provided for run A – the QLSPA comparison run (Table 21 and Fig. 28). The common *F* ratio for age 14 fish for the period 1959-93 estimated in this run is 0.43. Three of the four independently estimated *F* ratios for the 1998-2001 period are lower than this. Corresponding to these estimates of *F*, the catchabilities estimated for all 5 tuning indices indicate lower catchability for older fish. Although this interpretation is consistent with the data and the assumption of constant natural mortality, there is some concern that there is very little information that confirms the presence of these older fish in the stock area.

Year effects are apparent in the residual plots for most of the tuning indices. In the case of the sentinel gillnet index, there is a temporal pattern in the residuals that was judged to be unacceptable during the diagnostic analyses. However, for comparison purposes with the 2000 assessment, this index was included in the comparison formulation. In keeping with the 2000 assessment, the GEAC index was not used in this formulation.

The comparison run indicated that the stock had declined from the mid-1980s to the early 1990s, but increased rapidly during 1993-1997 following the moratorium. Population biomass and spawner biomass was estimated to have decreased during 1998-2000. In this analysis the current (1 Jan. 2001) population biomass was estimated to be 156,000 t. and spawner biomass was estimated to be 92,000 t. Spawner biomass was predicted to decline further during the course of the current fishing year if the 15,000 t TAC is taken. The resulting estimate of spawner biomass for 1 April 2002 was 78,000 t.

Recruitment estimated from the comparison SPA has been variable, but shows a long-term decline between the mid-1970s and the early 1990s. Recruitment during the mid- to late-1990s does not appear to be strong, but has increased in 1997-1998. Note that the recent estimates of recruitment have more uncertainty associated with them than the historic estimates. These trends in recruitment are similar to those obtained from the year-class strength analyses (see Fig. 22).

Estimates of annual exploitation rate, expressed as percentage of 3+ numbers removed by the fishery, varied over time. Exploitation during the late 1970s to 1984 was typically between 10 and 15%, but increased rapidly to between 18 and 26% just prior to the moratorium in 1993. With the reopening of the fishery in 1997, exploitation rates were low in 1997 relative to the pre-moratorium period and increased to 12.7% in 1999, but declined to less than 10% in 2000, the last completed year of the fishery. Although overall exploitation has not been particularly high in the reopened fishery, exploitation on some year-classes is estimated to have exceeded the $F_{0.1}$reference level. Tagging results also indicate that exploitation rates have been high in Placentia Bay.

### 10.3 Projections and estimation of risk

Projections were carried out to 1 April 2003 for 3 TAC options for the 2002-2003 fishing season: 10,000 t, 15,000 t and 20,000 t. The input parameters for the projection are given in Table 22. Given the change in the fishing season from the calendar year to 1 April – 31 March and the convention that fish increment age on 1 January, the catch for a fishing season has to be appropriately apportioned to the two parts of the fishery year. This was done based on monthly catch data for 2000 and 2001 and the cumulative catch up to August 2001. Using these data it was assumed that 83% of the TAC would be caught in the period from 1 April to 31 December and 17% from 1 January to 31 March in both the 2001-2002 and 2002-2003 fishing seasons.

Methods of risk quantification differed among the three model approaches. For ADAPT the conditioned bootstrap method described by Mohn (1993), as implemented by Gavaris (1998) in ADAPT 2.0 software, was used. For QLSPA a profile quasi-likelihood method (Cadigan 1998) was applied in a similar manner to that carried out in the previous assessment (Brattey et al.

2000). For XSA, risk was quantified by Monte-Carlo simulation on the final population numbers assuming a log-normal distribution and a CV equal to the standard errors of the survivor estimates as given by the XSA output. These standard errors are derived only from the fleets' catchability at age standard errors and are assumed log-normal (Darby and Flatman, 1994). The XSA risk simulations were carried using @Risk software in a spreadsheet framework.

Some preliminary precautionary biological reference points were suggested for 3Ps cod by Shelton (2000). These included both fishing mortality reference points and spawner biomass reference points. Although the concept of a precautionary approach is well established within DFO, this has not led to the development of recognized target and limit reference points for use in decision making. It is generally acknowledged that the development of targets would require broad debate. However, in the case of limits, some argue that the basis should almost entirely be scientific, while others argue for a social, economic and political considerations to factor into determining limits as well as targets. In the absence of operational precautionary approach in groundfish, this assessment chose three preliminary reference points for 3Ps cod which may be of use in current decision making regarding TACs and other management actions.

Risk was evaluated with respect to three reference points:

i) population decline, a stock-rebuilding reference;

ii) $F = F_{0.1}$, a limit reference point (only a small probabilty of exeeding it should be tolerated under a precautionary approach, e.g. a 10% probability);

iii) $F = 0.5 * F_{0.1}$, a target reference point (fishing mortality to be aimed for – i.e. a 50% probability).

The results are given in Table 23. The improvement in recruitment in recent years is predicted to result in an increase in spawner biomass. Four out of five of the SPA formulations predicted a <5% probability of spawner biomass declining between 1 April 2002 and 1 April 2003 over a range of TAC options from 10,000 to 20,000 t. The risk of exceeding the $F_{0.1}$ limit reference level was greater than 5% in 2 of the 5 formulations for a TAC of 10,000 t and greater than 5% in 3 out of 5 formulations for a TAC of 15,000 t. The risk of exceeding the target reference point of half $F_{0.1}$ was above 50% for 3 out of 5 formulations at a TAC of 10,000 t and above 50% for 4 out of 5 formulations for a TAC of 15,000 t.

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Table 1. Reported landings of cod (t) from NAFO Subdiv. 3Ps, 1959 - 1 Oct 2001 by country and for fixed and mobile gear sectors.

| | Can (N) | | Can (M) | France | | | | Spain | Portugal | Others | Total | TAC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Offshore | Inshore | | | St. P & M | | Metro | | | | | |
| Year | (Mobile) | (Fixed) | (All gears) | Inshore | | Offshore | (All gears) | (All gears) | (All gears) | (All gears) | | |
| 1959 | 2,726 | 32,718 | 4,784 | 3,078 | | | 4,952 | 7,794 | 3,647 | 471 | 60,170 | |
| 1960 | 1,780 | 40,059 | 5,095 | 3,424 | | 210 | 2,460 | 17,223 | 2,658 | 4,376 | 77,285 | |
| 1961 | 2,167 | 32,506 | 3,883 | 3,793 | | 347 | 11,490 | 21,015 | 6,070 | 5,553 | 86,824 | |
| 1962 | 1,176 | 29,888 | 1,474 | 2,171 | | 70 | 4,138 | 10,289 | 3,542 | 2,491 | 55,239 | |
| 1963 | 1,099 | 30,447 | 331 | 1,112 | | 645 | 324 | 10,826 | 209 | 6,828 | 51,821 | |
| 1964 | 2,161 | 23,897 | 370 | 1,002 | | 1,095 | 2,777 | 15,216 | 169 | 9,880 | 56,567 | |
| 1965 | 2,459 | 25,902 | 1,203 | 1,863 | | 707 | 1,781 | 13,404 | | 4,534 | 51,853 | |
| 1966 | 5,473 | 23,785 | 583 | - | | 3,207 | 4,607 | 23,678 | 519 | 4,355 | 66,207 | |
| 1967 | 3,861 | 26,331 | 1,259 | | 2,244 | | 3,204 | 20,851 | 980 | 4,044 | 62,774 | |
| 1968 | 6,536 | 22,938 | 585 | - | | 880 | 1,126 | 26,868 | 8 | 18,613 | 77,556 | |
| 1969 | 4,269 | 20,009 | 849 | - | | 2,477 | 15 | 28,141 | 57 | 7,982 | 63,799 | |
| 1970 | 4,650 | 23,410 | 2,166 | 1,307 | | 663 | 35 | 35,750 | 143 | 8,734 | 76,858 | |
| 1971 | 8,657 | 26,651 | 731 | 1,196 | | 455 | 2,730 | 19,169 | 81 | 2,778 | 62,448 | |
| 1972 | 3,323 | 19,276 | 252 | 990 | | 446 | - | 18,550 | 109 | 1,267 | 44,213 | |
| 1973 | 3,107 | 21,349 | 181 | 976 | | 189 | - | 19,952 | 1,180 | 5,707 | 52,641 | 70,500 |
| 1974 | 3,770 | 15,999 | 657 | 600 | | 348 | 5,366 | 14,937 | 1,246 | 3,789 | 46,712 | 70,000 |
| 1975 | 741 | 14,332 | 122 | 586 | | 189 | 3,549 | 12,234 | 1,350 | 2,270 | 35,373 | 62,400 |
| 1976 | 2,013 | 20,978 | 317 | 722 | | 182 | 1,501 | 9,236 | 177 | 2,007 | 37,133 | 47,500 |
| 1977 | 3,333 | 23,755 | 2,171 | 845 | | 407 | 1,734 | - | - | | 32,245 | 32,500 |
| 1978 | 2,082 | 19,560 | 700 | 380 | | 1,614 | 2,860 | - | - | 45 | 27,221 | 25,000 |
| 1979 | 2,381 | 23,413 | 863 | 495 | | 3,794 | 2,060 | - | - | - | 33,006 | 25,000 |
| 1980 | 2,809 | 29,427 | 715 | 214 | | 1,722 | 2,681 | - | - | - | 37,568 | 28,000 |
| 1981 | 2,696 | 26,068 | 2,321 | 333 | | 3,768 | 3,706 | - | - | - | 38,892 | 30,000 |
| 1982 | 2,639 | 21,351 | 2,948 | 1,009 | | 3,771 | 2,184 | - | - | - | 33,902 | 33,000 |
| 1983 | 2,100 | 23,915 | 2,580 | 843 | | 4,775 | 4,238 | - | - | - | 38,451 | 33,000 |
| 1984 | 895 | 22,865 | 1,969 | 777 | | 6,773 | 3,671 | - | - | - | 36,950 | 33,000 |
| 1985 | 4,529 | 24,854 | 3,476 | 642 | | 9,422 | 8,444 | - | - | - | 51,367 | 41,000 |
| 1986 | 5,218 | 24,821 | 1,963 | 389 | | 13,653 | 11,939 | - | - | 7 | 57,990 | 41,000 |
| 1987 | 4,133 | 26,735 | 2,517 | 551 | | 15,303 | 9,965 | - | - | - | 59,204 | 41,000 |
| 1988 | 3,682 | 19,742 | 2,308 | 282 | | 10,011 | 7,373 | - | - | 4 | 43,382 | 41,000 |
| 1989 | 3,098 | 23,208 | 2,361 | 339 | | 9,642 | 892 | - | - | - | 39,540 | 35,400 |
| 1990 | 3,266 | 20,128 | 3,082 | 158 | 14,929 | 14,771 | - | - | - | - | 41,405 | 35,400 |
| 1991 | 3,916 | 21,778 | 2,106 | 204 | 15,789 | 15,585 | - | - | - | - | 43,589 | 35,400 |
| 1992 | 4,468 | 19,025 | 2,238 | 2 | 10,164 | 10,162 | - | - | - | - | 35,895 | 35,400 |
| 1993 [1] | 1,987 | 11,678 | 1,351 | - | | - | - | - | - | - | 15,216 | 20,000 |
| 1994 [1] | 82 | 493 | 86 | - | | - | - | - | - | - | 661 | 0 |
| 1995 [1] | 26 | 555 | 60 | - | | - | - | - | - | - | 641 | 0 |
| 1996 [1] | 60 | 707 [2] | 118 | | | | | | | | 885 | 0 |
| 1997 [1] | 122 | 7,205 [2] | 79 | 448 | | 1,191 | | | | | 9,045 | 10,000 |
| 1998 [1] | 4,320 | 11,370 [2] | 885 | 609 | | 2,511 | | | | | 19,694 | 20,000 |
| 1999 [1] | 3,097 | 21,231 [2] | 614 | 621 | | 2,548 | | | | | 28,111 | 30,000 |
| 2000 [1] | 3,436 | 16,247 [2] | 740 | 870 | | 3,807 | | | | | 25,100 [4] | |
| 2001 [3] | 1,146 | 6,797 | 683 | | | 868 | | | | | 9,494 [4] | |

[1] Provisional catches

[2] Includes food fishery and sentinel fishery.

[3] Catch for Canada and France to 1 October 2001.

[4] TAC's are now set for the period 1 April to 31 March rather than by calender year and
the TAC was 20,000 t for 2000-2001 and 15,000 t for 2001-2002.

Table 2. Reported fixed gear catches of cod (t) from NAFO Subdivision 3Ps by gear type. (Includes non-Canadian catch)

| Year | | Gillnet | Longline | Handline | Trap | Total |
|---|---|---|---|---|---|---|
| 1975 | | 4995 | 4083 | 1364 | 3902 | 14344 |
| 1976 | | 5983 | 5439 | 2346 | 7224 | 20992 |
| 1977 | | 3612 | 9940 | 3008 | 7205 | 23765 |
| 1978 | | 2374 | 11893 | 3130 | 2245 | 19642 |
| 1979 | | 3955 | 14462 | 3123 | 2030 | 23570 |
| 1980 | | 5493 | 19331 | 2545 | 2077 | 29446 |
| 1981 | | 4998 | 20540 | 1142 | 948 | 27628 |
| 1982 | | 6283 | 13574 | 1597 | 1929 | 23383 |
| 1983 | | 6144 | 12722 | 2540 | 3643 | 25049 |
| 1984 | | 7275 | 9580 | 2943 | 3271 | 23069 |
| 1985 | | 7086 | 10596 | 1832 | 5674 | 25188 |
| 1986 | | 8668 | 11014 | 1634 | 4073 | 25389 |
| 1987 | | 9304 | 11807 | 1628 | 4931 | 27670 |
| 1988 | | 6433 | 10175 | 1469 | 2449 | 20526 |
| 1989 | | 5997 | 10758 | 1657 | 5996 | 24408 |
| 1990 | | 6948 | 8792 | 2217 | 3788 | 21745 |
| 1991 | | 6791 | 10304 | 1832 | 4068 | 22995 |
| 1992 | | 5314 | 10315 | 1330 | 3397 | 20356 |
| 1993 | | 3975 | 3783 | 1204 | 3557 | 12519 |
| 1994 | | 90 | 0 | 381 | 0 | 471 |
| 1995 | | 383 | 182 | 0 | 5 | 570 |
| 1996 | | 467 | 158 | 137 | 10 | 772 |
| 1997 | | 3760 | 1158 | 1172 | 1167 | 7258 |
| 1998 | [1] | 10116 | 2914 | 308 | 92 | 13430 |
| 1999 | [1] | 17976 | 3714 | 503 | 45 | 22237 |
| 2000 | [1] | 14218 | 3100 | 186 | 56 | 17561 |
| 2001 | [2] | 4374 | 1378 | 1427 | 44 | 7222 |

[1] provisional catch

[2] provisional catch to October 1st 2001

Table 3a. Reported monthly landings (t) of cod from NAFO Subdiv. 3Ps by gear type for 2000 and 2001 (to 1 Oct 2001, except for some gillnet and linetrawl catch data for October).

| 2000 | Offshore | | | Inshore | | | | |
|---|---|---|---|---|---|---|---|---|
| MONTH | Otter trawl | Gillnet | Line trawl | Gillnet | Line trawl | Handline | Trap | Total |
| Jan | 1188.6 | 3.9 | 79.2 | 938.5 | 22.4 | 6.8 | 0.0 | 2239.5 |
| Feb | 2073.1 | 63.2 | 222.0 | 1304.6 | 1.9 | 5.8 | 0.0 | 3670.7 |
| Mar | 1077.5 | 144.6 | 188.3 | 808.8 | 153.8 | 2.0 | 0.0 | 2375.0 |
| Apr | 47.9 | 40.9 | 131.0 | 0.0 | 0.0 | 0.0 | 0.0 | 219.9 |
| May | 5.7 | 0.0 | 20.8 | 20.5 | 35.2 | 1.5 | 0.0 | 83.7 |
| Jun | 40.1 | 771.9 | 20.4 | 2065.8 | 334.7 | 20.2 | 2.9 | 3255.9 |
| Jul | 12.8 | 440.9 | 4.7 | 1312.6 | 65.1 | 8.3 | 48.7 | 1893.0 |
| Aug | 0.3 | 341.2 | 14.1 | 267.3 | 13.7 | 1.1 | 2.2 | 639.8 |
| Sep | 110.5 | 1117.7 | 74.5 | 338.2 | 578.6 | 19.5 | 0.0 | 2239.0 |
| Oct | 868.3 | 482.7 | 12.4 | 326.1 | 125.5 | 26.4 | 0.1 | 1841.4 |
| Nov | 1256.4 | 592.0 | 55.4 | 2428.1 | 772.0 | 69.3 | 0.0 | 5173.1 |
| Dec | 858.6 | 13.6 | 15.3 | 395.5 | 159.0 | 25.0 | 0.0 | 1466.9 |
| TOTAL | 7539.7 | 4012.5 | 838.0 | 10205.9 | 2261.9 | 185.8 | 54.0 | 25097.8 |

| 2001 | Offshore | | | Inshore | | | | |
|---|---|---|---|---|---|---|---|---|
| MONTH | Otter trawl | Gillnet | Line trawl | Gillnet | Line trawl | Handline | Trap | Total |
| Jan | 699.5 | 0.0 | 27.4 | 860.9 | 21.8 | 0.0 | 0.0 | 1609.6 |
| Feb | 925.8 | 0.0 | 143.1 | 2.1 | 0.7 | 24.4 | 0.0 | 1096.2 |
| Mar | 538.8 | 24.4 | 147.0 | 44.9 | 0.2 | 0.0 | 0.0 | 755.4 |
| Apr | 23.1 | 0.0 | 2.4 | 0.2 | 0.3 | 0.0 | 0.0 | 25.8 |
| May | 45.7 | 0.0 | 67.2 | 0.5 | 11.4 | 1.1 | 0.0 | 125.9 |
| Jun | 4.4 | 5.7 | 15.1 | 780.7 | 99.3 | 379.0 | 9.6 | 1293.7 |
| Jul | 4.0 | 34.2 | 22.0 | 885.1 | 192.9 | 775.0 | 22.5 | 1935.8 |
| Aug | 7.1 | 87.0 | 69.4 | 618.5 | 273.2 | 217.3 | 11.4 | 1283.9 |
| Sep | 23.9 | 27.0 | 24.0 | 873.0 | 260.1 | 29.8 | 0.0 | 1237.8 |
| Oct | | | | 130.1 | 0.3 | | | 130.4 |
| Nov | | | | | | | | |
| Dec | | | | | | | | |
| TOTAL | 2272.4 | 178.3 | 517.6 | 4195.8 | 860.0 | 1426.7 | 43.6 | 9494.4 |

Table 3b. Reported monthly landings (t) of cod from unit areas in NAFO Subdiv. 3Ps during 2000 and 2001 (to 1 Oct 2001).

| 2000 | Inshore | | | Offshore | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Month | 3Psa | 3Psb | 3Psc | 3Psd | 3Pse | 3Psf | 3Psg | 3Psh | 3Ps_unk |
| Jan | 3.1 | 4.0 | 962.2 | 11.4 | 0.0 | 10.0 | 4.9 | 1243.8 | 0.0 |
| Feb | 3.9 | 1.2 | 1310.1 | 0.0 | 0.0 | 0.0 | 7.0 | 2348.5 | 0.0 |
| Mar | 173.9 | 626.6 | 164.2 | 1.6 | 0.0 | 0.0 | 11.4 | 1397.3 | 0.0 |
| Apr | 3.4 | 0.0 | 0.0 | 12.0 | 0.0 | 7.4 | 0.7 | 196.5 | 0.0 |
| May | 29.4 | 23.7 | 4.1 | 5.7 | 0.0 | 0.3 | 0.5 | 20.1 | 0.0 |
| Jun | 378.6 | 741.5 | 1309.3 | 28.6 | 52.4 | 624.0 | 12.5 | 109.3 | 0.0 |
| Jul | 122.0 | 152.9 | 1159.8 | 14.3 | 206.0 | 179.6 | 3.3 | 55.1 | 0.0 |
| Aug | 28.1 | 37.2 | 219.3 | 7.3 | 227.1 | 74.8 | 11.0 | 35.2 | 0.0 |
| Sep | 386.2 | 298.0 | 262.3 | 115.2 | 280.2 | 648.7 | 44.9 | 192.3 | 13.1 |
| Oct | 10.5 | 4.6 | 485.3 | 0.0 | 127.0 | 779.1 | 14.2 | 420.7 | 0.0 |
| Nov | 537.6 | 319.2 | 2412.6 | 51.5 | 104.1 | 837.3 | 34.6 | 876.1 | 0.0 |
| Dec | 41.6 | 54.1 | 484.4 | 1.3 | 6.0 | 22.0 | 10.9 | 846.7 | 0.0 |
| Totals | 1718.3 | 2263.0 | 8773.6 | 248.9 | 1002.8 | 3183.1 | 155.8 | 7741.6 | 13.1 |

| 2001 | Inshore | | | Offshore | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Month | 3Psa | 3Psb | 3Psc | 3Psd | 3Pse | 3Psf | 3Psg | 3Psh | 3Ps_unk |
| Jan | 0.4 | 22.0 | 880.2 | 1.0 | 9.4 | 143.7 | 3.4 | 549.5 | 0.0 |
| Feb | 0.4 | 4.3 | 26.1 | 6.2 | 119.7 | 270.0 | 7.1 | 662.4 | 0.0 |
| Mar | 2.7 | 15.0 | 31.0 | 58.6 | 57.7 | 222.6 | 1.3 | 364.6 | 1.9 |
| Apr | 0.3 | 0.0 | 0.2 | 6.8 | 1.2 | 1.2 | 0.0 | 16.2 | 0.0 |
| May | 12.5 | 5.4 | 1.5 | 31.5 | 32.8 | 0.0 | 0.0 | 42.2 | 0.0 |
| Jun | 131.5 | 424.1 | 717.3 | 2.8 | 13.0 | 0.7 | 0.1 | 4.2 | 0.0 |
| Jul | 183.4 | 499.8 | 1195.8 | 15.4 | 7.9 | 4.6 | 0.0 | 11.8 | 17.2 |
| Aug | 142.0 | 447.9 | 537.5 | 49.7 | 19.9 | 10.3 | 10.1 | 27.8 | 38.8 |
| Sep | 168.5 | 522.4 | 495.1 | 2.2 | 2.0 | 24.9 | 14.3 | 7.0 | 1.5 |
| Oct | 3.8 | 76.7 | 49.9 | | | | | | |
| Nov | | | | | | | | | |
| Dec | | | | | | | | | |
| Totals | 645.4 | 2017.7 | 3934.5 | 174.1 | 263.5 | 677.9 | 36.3 | 1685.7 | 59.3 |

Table 3c. Reported monthly landings (t) of cod from unit areas in NAFO Subdiv. 3Ps during the management year 1 April 2000 to 31 March 2001.

| | Inshore | | | Offshore | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 3Psa | 3Psb | 3Psc | 3Psd | 3Pse | 3Psf | 3Psg | 3Psh | 3Ps_unk |
| 2000 | 3.4 | 0.0 | 0.0 | 12.0 | 0.0 | 7.4 | 0.7 | 196.5 | 0.0 |
| May | 29.4 | 23.7 | 4.1 | 5.7 | 0.0 | 0.3 | 0.5 | 20.1 | 0.0 |
| Jun | 378.6 | 741.5 | 1309.3 | 28.6 | 52.4 | 624.0 | 12.5 | 109.3 | 0.0 |
| Jul | 122.0 | 152.9 | 1159.8 | 14.3 | 206.0 | 179.6 | 3.3 | 55.1 | 0.0 |
| Aug | 28.1 | 37.2 | 219.3 | 7.3 | 227.1 | 74.8 | 11.0 | 35.2 | 0.0 |
| Sep | 386.2 | 298.0 | 262.3 | 115.2 | 280.2 | 648.7 | 44.9 | 192.3 | 13.1 |
| Oct | 10.5 | 4.6 | 485.3 | 0.0 | 127.0 | 779.1 | 14.2 | 420.7 | 0.0 |
| Nov | 537.6 | 319.2 | 2412.6 | 51.5 | 104.1 | 837.3 | 34.6 | 876.1 | 0.0 |
| Dec | 41.6 | 54.1 | 484.4 | 1.3 | 6.0 | 22.0 | 10.9 | 846.7 | 0.0 |
| 2001 | | | | | | | | | |
| Jan | 0.4 | 22.0 | 880.2 | 1.0 | 9.4 | 143.7 | 3.4 | 549.5 | 0.0 |
| Feb | 0.4 | 4.3 | 26.1 | 6.2 | 119.7 | 270.0 | 7.1 | 662.4 | 0.0 |
| Mar | 2.7 | 15.0 | 31.0 | 58.6 | 57.7 | 222.6 | 1.3 | 364.6 | 1.9 |
| Totals | 1540.9 | 1672.6 | 7274.4 | 301.7 | 1189.5 | 3809.3 | 144.3 | 4328.5 | 15.0 |

Table 4. Number of cod sampled (commercial fishery and Sentinel survey) for length and age and used to estimate the 3Ps commercial catch at age for 2000

| | Number Measured | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Offshore | | | Inshore | | | | |
| Month | Ottertrawl | Gillnet | Line-trawl | Gillnet | Line-trawl | Handline | Trap | Total |
| Jan | 5751 | | | 2295 | 2673 | | | 10719 |
| Feb | 7546 | | | 3348 | 786 | | | 11680 |
| Mar | 3662 | | | 7181 | 1804 | | | 12647 |
| Apr | | | | | | | | 0 |
| May | | 320 | | 261 | 678 | | | 1259 |
| Jun | 624 | 4606 | 638 | 5414 | 103036 | | | 114318 |
| Jul | | 996 | | 4344 | 1277 | | 3012 | 9629 |
| Aug | | | | 944 | 2334 | 147 | | 3425 |
| Sep | | 2322 | | 340 | 8269 | | | 10931 |
| Oct | 957 | 516 | | 406 | 3781 | | | 5660 |
| Nov | 2296 | | | 6409 | 7540 | 677 | | 16922 |
| Dec | 1414 | | | | | | | 1414 |
| Total | 22250 | 8760 | 638 | 30942 | 132178 | 824 | 3012 | 198604 |

| | Number Aged | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Offshore | | | Inshore | | | | |
| QTR | Ottertrawl | Gillnet | Line-trawl | Gillnet | Line-trawl | Handline | Trap | Total |
| 1 | 1466 | | | 495 | 402 | | | 2363 |
| 2 | 19 | 289 | | 1305 | 326 | | | 1939 |
| 3 | | 788 | 48 | 1337 | 1346 | | 29 | 3548 |
| 4 | 935 | 400 | | 1016 | 1511 | 136 | | 3998 |
| Total | 2420 | 1477 | 48 | 4153 | 3585 | 136 | 29 | 11848 |

Table 5a. Estimates of average weight (kg), length (cm) and numbers-st-age (000's) for Canadian landings together with French catch and the resulting total catch numbers at age for cod in 3Ps in 2000.

| CANADIAN | | | | | | FRENCH | TOTAL |
|---|---|---|---|---|---|---|---|
| AGE | AVERAGE WEIGHT (kg.) | LENGTH (cm.) | CATCH NUMBER (000's) | SE | CV | CATCH NUMBER (000's) | CATCH NUMBER (000's) |
| 1 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2 | 0.31 | 33.04 | 0.69 | 0.23 | 0.34 | 0.00 | 0.69 |
| 3 | 0.62 | 40.92 | 76.24 | 4.72 | 0.06 | 0.00 | 76.24 |
| 4 | 0.90 | 46.39 | 331.29 | 10.21 | 0.03 | 4.00 | 335.30 |
| 5 | 1.36 | 53.20 | 717.13 | 16.89 | 0.02 | 18.65 | 735.78 |
| 6 | 2.07 | 60.83 | 1247.58 | 26.73 | 0.02 | 104.81 | 1352.39 |
| 7 | 2.74 | 66.63 | 1485.73 | 29.40 | 0.02 | 206.41 | 1692.14 |
| 8 | 2.81 | 67.26 | 1395.58 | 29.23 | 0.02 | 88.92 | 1484.49 |
| 9 | 3.15 | 69.59 | 550.28 | 19.83 | 0.04 | 59.77 | 610.05 |
| 10 | 4.60 | 78.14 | 425.66 | 12.87 | 0.03 | 104.65 | 530.31 |
| 11 | 6.54 | 87.92 | 551.97 | 9.65 | 0.02 | 72.16 | 624.13 |
| 12 | 6.12 | 85.78 | 76.54 | 4.73 | 0.06 | 15.49 | 92.02 |
| 13 | 6.42 | 87.53 | 34.77 | 3.07 | 0.09 | 2.68 | 37.45 |
| 14 | 7.73 | 92.57 | 14.49 | 1.77 | 0.12 | 1.72 | 16.21 |
| 15 | 8.09 | 94.38 | 6.54 | 0.94 | 0.14 | 0.00 | 6.54 |
| 16 | 8.41 | 95.78 | 2.25 | 0.68 | 0.30 | 0.30 | 2.55 |
| 17 | 10.94 | 104.23 | 0.54 | 0.29 | 0.54 | 0.30 | 0.84 |
| 18 | 14.61 | 115.51 | 0.43 | 0.11 | 0.26 | 0.00 | 0.43 |
| 19 | 16.63 | 121.00 | 0.05 | 0.03 | 0.58 | 0.00 | 0.05 |
| 20 | 14.90 | 116.32 | 0.14 | 0.06 | 0.42 | 0.00 | 0.14 |
| 21 | 16.80 | 121.41 | 0.05 | 0.03 | 0.53 | 0.00 | 0.05 |
| 22 | 16.00 | 119.37 | 0.27 | 0.00 | 0.01 | 0.00 | 0.27 |

Table 5b. Preliminary estimates of average weight (kg), length (cm) and numbers-st-age (000's) for Canadian landings together with French catch and the resulting total catch numbers at age for cod in 3Ps, Jan-March 2001.

| CANADIAN | | | | | | FRENCH | TOTAL |
|---|---|---|---|---|---|---|---|
| AGE | AVERAGE WEIGHT (kg.) | LENGTH (cm.) | CATCH NUMBER (000's) | SE | CV | CATCH NUMBER (000's) | CATCH NUMBER (000's) |
| 1 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 3 | 0.47 | 37.83 | 0.29 | 0.08 | 0.29 | 0.00 | 0.29 |
| 4 | 1.05 | 49.02 | 19.46 | 1.86 | 0.10 | 3.91 | 23.37 |
| 5 | 1.32 | 52.74 | 31.11 | 2.20 | 0.07 | 12.87 | 43.97 |
| 6 | 1.89 | 59.12 | 39.05 | 4.13 | 0.11 | 19.04 | 58.09 |
| 7 | 2.91 | 67.87 | 121.63 | 7.29 | 0.06 | 31.48 | 153.10 |
| 8 | 3.42 | 71.20 | 119.85 | 7.78 | 0.06 | 24.75 | 144.60 |
| 9 | 3.28 | 70.48 | 93.01 | 7.64 | 0.08 | 10.57 | 103.58 |
| 10 | 3.53 | 72.33 | 48.72 | 5.70 | 0.12 | 12.99 | 61.71 |
| 11 | 6.47 | 87.24 | 50.90 | 4.04 | 0.08 | 20.59 | 71.49 |
| 12 | 9.14 | 98.91 | 70.96 | 3.02 | 0.04 | 12.69 | 83.65 |
| 13 | 8.18 | 94.92 | 16.63 | 1.79 | 0.11 | 2.22 | 18.85 |
| 14 | 8.21 | 94.28 | 5.35 | 1.01 | 0.19 | 1.48 | 6.83 |
| 15 | 8.59 | 96.36 | 2.45 | 0.61 | 0.25 | 0.48 | 2.93 |
| 16 | 11.21 | 106.03 | 1.25 | 0.40 | 0.32 | 0.00 | 1.25 |
| 17 | 16.63 | 121.00 | 0.12 | 0.09 | 0.73 | 0.00 | 0.12 |
| 18 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 19 | 15.39 | 118.00 | 0.14 | 0.11 | 0.78 | 0.00 | 0.14 |
| 20 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 21 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 22 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

Table 6. Catch numbers (000's) at age for the commercial cod fishery in NAFO Subdiv. 3Ps, all gears combined, from 1959-2001.

| Year/Age | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1959 | 0 | 1001 | 13940 | 7525 | 7265 | 4875 | 942 | 1252 | 1260 | 631 | 545 | 44 | 1 |
| 1960 | 0 | 567 | 5496 | 23704 | 6714 | 3476 | 3484 | 1020 | 827 | 406 | 407 | 283 | 27 |
| 1961 | 0 | 450 | 5586 | 10357 | 15960 | 3616 | 4680 | 1849 | 1376 | 446 | 265 | 560 | 58 |
| 1962 | 0 | 1245 | 6749 | 9003 | 4533 | 5715 | 1367 | 791 | 571 | 187 | 140 | 135 | 241 |
| 1963 | 0 | 961 | 4499 | 7091 | 5275 | 2527 | 3030 | 898 | 292 | 143 | 99 | 107 | 92 |
| 1964 | 0 | 1906 | 5785 | 5635 | 5179 | 2945 | 1881 | 1891 | 652 | 339 | 329 | 54 | 27 |
| 1965 | 0 | 2314 | 9636 | 5799 | 3609 | 3254 | 2055 | 1218 | 1033 | 327 | 68 | 122 | 36 |
| 1966 | 0 | 949 | 13662 | 13065 | 4621 | 5119 | 1586 | 1833 | 1039 | 517 | 389 | 32 | 22 |
| 1967 | 0 | 2871 | 10913 | 12900 | 6392 | 2349 | 1364 | 604 | 316 | 380 | 95 | 149 | 3 |
| 1968 | 0 | 1143 | 12602 | 13135 | 5853 | 3572 | 1308 | 549 | 425 | 222 | 111 | 5 | 107 |
| 1969 | 0 | 774 | 7098 | 11585 | 7178 | 4554 | 1757 | 792 | 717 | 61 | 120 | 67 | 110 |
| 1970 | 0 | 756 | 8114 | 12916 | 9763 | 6374 | 2456 | 730 | 214 | 178 | 77 | 121 | 14 |
| 1971 | 0 | 2884 | 6444 | 8574 | 7266 | 8218 | 3131 | 1275 | 541 | 85 | 125 | 62 | 57 |
| 1972 | 0 | 731 | 4944 | 4591 | 3552 | 4603 | 2636 | 833 | 463 | 205 | 117 | 48 | 45 |
| 1973 | 0 | 945 | 4707 | 11386 | 4010 | 4022 | 2201 | 2019 | 515 | 172 | 110 | 14 | 29 |
| 1974 | 0 | 1887 | 6042 | 9987 | 6365 | 2540 | 1857 | 1149 | 538 | 249 | 80 | 32 | 17 |
| 1975 | 0 | 1840 | 7329 | 5397 | 4541 | 5867 | 723 | 1196 | 105 | 174 | 52 | 6 | 2 |
| 1976 | 0 | 4110 | 12139 | 7923 | 2875 | 1305 | 495 | 140 | 53 | 17 | 21 | 4 | 3 |
| 1977 | 0 | 935 | 9156 | 8326 | 3209 | 920 | 395 | 265 | 117 | 57 | 43 | 31 | 11 |
| 1978 | 0 | 502 | 5146 | 6096 | 4006 | 1753 | 653 | 235 | 178 | 72 | 27 | 17 | 10 |
| 1979 | 0 | 135 | 3072 | 10321 | 5066 | 2353 | 721 | 233 | 84 | 53 | 24 | 13 | 10 |
| 1980 | 0 | 368 | 1625 | 5054 | 8156 | 3379 | 1254 | 327 | 114 | 56 | 45 | 21 | 25 |
| 1981 | 0 | 1022 | 2888 | 3136 | 4652 | 5855 | 1622 | 539 | 175 | 67 | 35 | 18 | 2 |
| 1982 | 0 | 130 | 5092 | 4430 | 2348 | 2861 | 2939 | 640 | 243 | 83 | 30 | 11 | 7 |
| 1983 | 0 | 760 | 2682 | 9174 | 4080 | 1752 | 1150 | 1041 | 244 | 91 | 37 | 18 | 8 |
| 1984 | 0 | 203 | 4521 | 4538 | 7018 | 2221 | 584 | 542 | 338 | 134 | 35 | 8 | 8 |
| 1985 | 0 | 152 | 2639 | 8031 | 5144 | 5242 | 1480 | 626 | 545 | 353 | 109 | 21 | 6 |
| 1986 | 0 | 306 | 5103 | 10253 | 11228 | 4283 | 2167 | 650 | 224 | 171 | 143 | 79 | 23 |
| 1987 | 0 | 585 | 2956 | 11023 | 9763 | 5453 | 1416 | 1107 | 341 | 149 | 78 | 135 | 50 |
| 1988 | 0 | 935 | 4951 | 4971 | 6471 | 5046 | 1793 | 630 | 284 | 123 | 75 | 53 | 31 |
| 1989 | 0 | 1071 | 8995 | 7842 | 2863 | 2549 | 1112 | 600 | 223 | 141 | 57 | 29 | 26 |
| 1990 | 0 | 2006 | 8622 | 8195 | 3329 | 1483 | 1237 | 692 | 350 | 142 | 104 | 47 | 22 |
| 1991 | 0 | 812 | 7981 | 10028 | 5907 | 2164 | 807 | 620 | 428 | 108 | 76 | 50 | 22 |
| 1992 | 0 | 1422 | 4159 | 8424 | 6538 | 2266 | 658 | 269 | 192 | 187 | 83 | 34 | 41 |
| 1993 | 0 | 278 | 3712 | 2035 | 3156 | 1334 | 401 | 89 | 38 | 52 | 13 | 14 | 5 |
| 1994 | 0 | 9 | 78 | 173 | 74 | 62 | 28 | 12 | 3 | 2 | 0 | 0 | 0 |
| 1995 | 0 | 3 | 7 | 56 | 119 | 57 | 37 | 7 | 2 | 0 | 0 | 0 | 0 |
| 1996 | 0 | 9 | 43 | 43 | 101 | 125 | 35 | 24 | 8 | 2 | 1 | 0 | 0 |
| 1997 | 0 | 66 | 427 | 1130 | 497 | 937 | 826 | 187 | 93 | 31 | 4 | 1 | 0 |
| 1998 | 0 | 91 | 373 | 793 | 1550 | 948 | 1314 | 1217 | 225 | 120 | 56 | 15 | 1 |
| 1999 | 0 | 49 | 628 | 1202 | 2156 | 2321 | 1020 | 960 | 873 | 189 | 110 | 21 | 8 |
| 2000 [1] | 0 | 1 | 6 | 80 | 204 | 455 | 380 | 213 | 249 | 320 | 49 | 25 | 12 |
| 2000 [2] | 1 | 76 | 335 | 736 | 1352 | 1692 | 1484 | 610 | 530 | 624 | 92 | 37 | 16 |
| 2001 [3] | 0 | 0 | 23 | 44 | 58 | 153 | 145 | 104 | 62 | 71 | 84 | 19 | 7 |
| 2001 [4] | 0 | 13 | 252 | 750 | 1514 | 1308 | 775 | 977 | 264 | 191 | 132 | 37 | 15 |

[1] catch-at-age during January-March 2000 as used in the October 2000 assessment

[2] final catch-at-age for 2000 as used in the October 2001 assessment

[3] catch-at-age during January-March 2001 as used in the October 2001 assessment

[4] catch-at-age during January-March 2001 projected to 31 December 2001

Table 7a. Mean annual weights-at-age (kg) calculated from lengths-at-age based on samples from commercial fisheries (including food fisheries and sentinel surveys) in NAFO Subdiv. 3Ps during 1959-2001. The weights-at-age from 1976 are extrapolated back to 1959 and the 2001 values are for January-March only.

| Year/age | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1959 | 0.28 | 0.69 | 1.08 | 1.68 | 2.40 | 3.21 | 4.10 | 5.08 | 6.03 | 7.00 | 8.05 | 9.16 |
| 1960 | 0.28 | 0.69 | 1.08 | 1.68 | 2.40 | 3.21 | 4.10 | 5.08 | 6.03 | 7.00 | 8.05 | 9.16 |
| 1961 | 0.28 | 0.69 | 1.08 | 1.68 | 2.40 | 3.21 | 4.10 | 5.08 | 6.03 | 7.00 | 8.05 | 9.16 |
| 1962 | 0.28 | 0.69 | 1.08 | 1.68 | 2.40 | 3.21 | 4.10 | 5.08 | 6.03 | 7.00 | 8.05 | 9.16 |
| 1963 | 0.28 | 0.69 | 1.08 | 1.68 | 2.40 | 3.21 | 4.10 | 5.08 | 6.03 | 7.00 | 8.05 | 9.16 |
| 1964 | 0.28 | 0.69 | 1.08 | 1.68 | 2.40 | 3.21 | 4.10 | 5.08 | 6.03 | 7.00 | 8.05 | 9.16 |
| 1965 | 0.28 | 0.69 | 1.08 | 1.68 | 2.40 | 3.21 | 4.10 | 5.08 | 6.03 | 7.00 | 8.05 | 9.16 |
| 1966 | 0.28 | 0.69 | 1.08 | 1.68 | 2.40 | 3.21 | 4.10 | 5.08 | 6.03 | 7.00 | 8.05 | 9.16 |
| 1967 | 0.28 | 0.69 | 1.08 | 1.68 | 2.40 | 3.21 | 4.10 | 5.08 | 6.03 | 7.00 | 8.05 | 9.16 |
| 1968 | 0.28 | 0.69 | 1.08 | 1.68 | 2.40 | 3.21 | 4.10 | 5.08 | 6.03 | 7.00 | 8.05 | 9.16 |
| 1969 | 0.28 | 0.69 | 1.08 | 1.68 | 2.40 | 3.21 | 4.10 | 5.08 | 6.03 | 7.00 | 8.05 | 9.16 |
| 1970 | 0.28 | 0.69 | 1.08 | 1.68 | 2.40 | 3.21 | 4.10 | 5.08 | 6.03 | 7.00 | 8.05 | 9.16 |
| 1971 | 0.28 | 0.69 | 1.08 | 1.68 | 2.40 | 3.21 | 4.10 | 5.08 | 6.03 | 7.00 | 8.05 | 9.16 |
| 1972 | 0.28 | 0.69 | 1.08 | 1.68 | 2.40 | 3.21 | 4.10 | 5.08 | 6.03 | 7.00 | 8.05 | 9.16 |
| 1973 | 0.28 | 0.69 | 1.08 | 1.68 | 2.40 | 3.21 | 4.10 | 5.08 | 6.03 | 7.00 | 8.05 | 9.16 |
| 1974 | 0.28 | 0.69 | 1.08 | 1.68 | 2.40 | 3.21 | 4.10 | 5.08 | 6.03 | 7.00 | 8.05 | 9.16 |
| 1975 | 0.28 | 0.69 | 1.08 | 1.68 | 2.40 | 3.21 | 4.10 | 5.08 | 6.03 | 7.00 | 8.05 | 9.16 |
| 1976 | 0.28 | 0.69 | 1.08 | 1.68 | 2.40 | 3.21 | 4.10 | 5.08 | 6.03 | 7.00 | 8.05 | 9.16 |
| 1977 | 0.55 | 0.68 | 1.30 | 1.86 | 2.67 | 3.42 | 4.19 | 4.94 | 5.92 | 6.76 | 8.78 | 10.90 |
| 1978 | 0.45 | 0.70 | 1.08 | 1.75 | 2.45 | 2.99 | 4.10 | 5.16 | 5.17 | 7.20 | 7.75 | 8.72 |
| 1979 | 0.41 | 0.65 | 1.01 | 1.65 | 2.55 | 3.68 | 4.30 | 6.49 | 7.00 | 8.20 | 9.53 | 10.84 |
| 1980 | 0.52 | 0.72 | 1.13 | 1.66 | 2.48 | 3.60 | 5.40 | 6.95 | 7.29 | 8.64 | 9.33 | 9.58 |
| 1981 | 0.48 | 0.79 | 1.32 | 1.80 | 2.30 | 3.27 | 4.36 | 5.68 | 7.41 | 9.04 | 8.39 | 9.56 |
| 1982 | 0.45 | 0.77 | 1.17 | 1.78 | 2.36 | 2.88 | 3.91 | 5.28 | 6.18 | 8.62 | 8.64 | 11.41 |
| 1983 | 0.58 | 0.84 | 1.33 | 1.99 | 2.58 | 3.26 | 3.77 | 5.04 | 6.56 | 8.45 | 10.06 | 11.82 |
| 1984 | 0.66 | 1.04 | 1.40 | 1.97 | 2.64 | 3.77 | 4.75 | 5.56 | 6.01 | 9.04 | 11.20 | 10.40 |
| 1985 | 0.63 | 0.85 | 1.23 | 1.79 | 2.81 | 3.44 | 5.02 | 6.01 | 6.11 | 7.18 | 9.81 | 10.48 |
| 1986 | 0.54 | 0.75 | 1.18 | 1.84 | 2.43 | 3.15 | 4.30 | 5.50 | 6.19 | 8.72 | 8.05 | 11.91 |
| 1987 | 0.56 | 0.77 | 1.21 | 1.63 | 2.31 | 3.02 | 4.33 | 5.11 | 6.20 | 6.98 | 7.08 | 8.34 |
| 1988 | 0.63 | 0.82 | 1.09 | 1.67 | 2.17 | 2.92 | 3.58 | 4.98 | 5.61 | 6.60 | 7.46 | 8.92 |
| 1989 | 0.63 | 0.81 | 1.16 | 1.63 | 2.25 | 3.37 | 4.11 | 5.18 | 6.29 | 7.30 | 7.75 | 8.73 |
| 1990 | 0.58 | 0.86 | 1.27 | 1.85 | 2.45 | 3.00 | 4.22 | 5.09 | 6.35 | 7.60 | 8.31 | 10.37 |
| 1991 | 0.60 | 0.75 | 1.17 | 1.74 | 2.37 | 2.91 | 3.69 | 4.23 | 6.34 | 7.68 | 8.64 | 9.72 |
| 1992 | 0.46 | 0.69 | 1.04 | 1.56 | 2.23 | 2.89 | 4.14 | 5.54 | 6.42 | 7.82 | 10.40 | 11.88 |
| 1993 | 0.36 | 0.68 | 1.08 | 1.48 | 2.13 | 2.82 | 4.34 | 4.30 | 4.68 | 7.49 | 6.85 | 8.24 |
| 1994 | 0.62 | 0.82 | 1.30 | 1.86 | 2.05 | 2.75 | 3.59 | 4.38 | 6.29 | 7.77 | 6.78 | 8.07 |
| 1995 | 0.52 | 0.85 | 1.57 | 2.03 | 2.47 | 2.78 | 3.46 | 4.30 | 4.27 | 4.16 | 5.59 | 9.24 |
| 1996 | 0.67 | 0.98 | 1.48 | 2.05 | 2.53 | 2.94 | 3.23 | 4.03 | 4.82 | 4.68 | 7.26 | 9.92 |
| 1997 | 0.62 | 0.90 | 1.30 | 1.87 | 2.51 | 3.24 | 3.47 | 3.52 | 4.59 | 6.37 | 8.58 | 10.73 |
| 1998 | 0.62 | 1.02 | 1.57 | 2.05 | 2.42 | 3.10 | 4.04 | 4.13 | 4.62 | 5.21 | 6.39 | 9.69 |
| 1999 | 0.70 | 0.92 | 1.57 | 2.31 | 2.53 | 2.82 | 3.92 | 5.32 | 4.99 | 5.27 | 6.14 | 7.27 |
| 2000 | 0.62 | 0.90 | 1.36 | 2.07 | 2.74 | 2.81 | 3.15 | 4.60 | 6.54 | 6.12 | 6.42 | 7.73 |
| 2001 | 0.58 | 0.91 | 1.44 | 1.83 | 2.32 | 2.82 | 3.08 | 3.47 | 4.76 | 7.62 | 7.05 | 8.07 |

Table. 7b. Beginning of the year weights-at-age calculated from commercial mean annual weights-at-age, as described in Lilly (1998). The 2001 values are for January-March only.

| Year/age | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1959 | 0.18 | 0.44 | 0.86 | 1.35 | 2.01 | 2.78 | 3.63 | 4.56 | 5.53 | 6.50 | 7.51 | 8.59 |
| 1960 | 0.18 | 0.44 | 0.86 | 1.35 | 2.01 | 2.78 | 3.63 | 4.56 | 5.53 | 6.50 | 7.51 | 8.59 |
| 1961 | 0.18 | 0.44 | 0.86 | 1.35 | 2.01 | 2.78 | 3.63 | 4.56 | 5.53 | 6.50 | 7.51 | 8.59 |
| 1962 | 0.18 | 0.44 | 0.86 | 1.35 | 2.01 | 2.78 | 3.63 | 4.56 | 5.53 | 6.50 | 7.51 | 8.59 |
| 1963 | 0.18 | 0.44 | 0.86 | 1.35 | 2.01 | 2.78 | 3.63 | 4.56 | 5.53 | 6.50 | 7.51 | 8.59 |
| 1964 | 0.18 | 0.44 | 0.86 | 1.35 | 2.01 | 2.78 | 3.63 | 4.56 | 5.53 | 6.50 | 7.51 | 8.59 |
| 1965 | 0.18 | 0.44 | 0.86 | 1.35 | 2.01 | 2.78 | 3.63 | 4.56 | 5.53 | 6.50 | 7.51 | 8.59 |
| 1966 | 0.18 | 0.44 | 0.86 | 1.35 | 2.01 | 2.78 | 3.63 | 4.56 | 5.53 | 6.50 | 7.51 | 8.59 |
| 1967 | 0.18 | 0.44 | 0.86 | 1.35 | 2.01 | 2.78 | 3.63 | 4.56 | 5.53 | 6.50 | 7.51 | 8.59 |
| 1968 | 0.18 | 0.44 | 0.86 | 1.35 | 2.01 | 2.78 | 3.63 | 4.56 | 5.53 | 6.50 | 7.51 | 8.59 |
| 1969 | 0.18 | 0.44 | 0.86 | 1.35 | 2.01 | 2.78 | 3.63 | 4.56 | 5.53 | 6.50 | 7.51 | 8.59 |
| 1970 | 0.18 | 0.44 | 0.86 | 1.35 | 2.01 | 2.78 | 3.63 | 4.56 | 5.53 | 6.50 | 7.51 | 8.59 |
| 1971 | 0.18 | 0.44 | 0.86 | 1.35 | 2.01 | 2.78 | 3.63 | 4.56 | 5.53 | 6.50 | 7.51 | 8.59 |
| 1972 | 0.18 | 0.44 | 0.86 | 1.35 | 2.01 | 2.78 | 3.63 | 4.56 | 5.53 | 6.50 | 7.51 | 8.59 |
| 1973 | 0.18 | 0.44 | 0.86 | 1.35 | 2.01 | 2.78 | 3.63 | 4.56 | 5.53 | 6.50 | 7.51 | 8.59 |
| 1974 | 0.18 | 0.44 | 0.86 | 1.35 | 2.01 | 2.78 | 3.63 | 4.56 | 5.53 | 6.50 | 7.51 | 8.59 |
| 1975 | 0.18 | 0.44 | 0.86 | 1.35 | 2.01 | 2.78 | 3.63 | 4.56 | 5.53 | 6.50 | 7.51 | 8.59 |
| 1976 | 0.18 | 0.44 | 0.86 | 1.35 | 2.01 | 2.78 | 3.63 | 4.56 | 5.53 | 6.50 | 7.51 | 8.59 |
| 1977 | 0.49 | 0.44 | 0.95 | 1.42 | 2.12 | 2.86 | 3.67 | 4.50 | 5.48 | 6.38 | 7.84 | 9.37 |
| 1978 | 0.37 | 0.62 | 0.86 | 1.51 | 2.13 | 2.83 | 3.74 | 4.65 | 5.05 | 6.53 | 7.24 | 8.75 |
| 1979 | 0.31 | 0.54 | 0.84 | 1.33 | 2.11 | 3.00 | 3.59 | 5.16 | 6.01 | 6.51 | 8.28 | 9.17 |
| 1980 | 0.42 | 0.54 | 0.86 | 1.29 | 2.02 | 3.03 | 4.46 | 5.47 | 6.88 | 7.78 | 8.75 | 9.55 |
| 1981 | 0.38 | 0.64 | 0.97 | 1.43 | 1.95 | 2.85 | 3.96 | 5.54 | 7.18 | 8.12 | 8.51 | 9.44 |
| 1982 | 0.33 | 0.61 | 0.96 | 1.53 | 2.06 | 2.57 | 3.58 | 4.80 | 5.92 | 7.99 | 8.84 | 9.78 |
| 1983 | 0.43 | 0.61 | 1.01 | 1.53 | 2.14 | 2.77 | 3.30 | 4.44 | 5.89 | 7.23 | 9.31 | 10.11 |
| 1984 | 0.58 | 0.78 | 1.08 | 1.62 | 2.29 | 3.12 | 3.94 | 4.58 | 5.50 | 7.70 | 9.73 | 10.23 |
| 1985 | 0.58 | 0.75 | 1.13 | 1.58 | 2.35 | 3.01 | 4.35 | 5.34 | 5.83 | 6.57 | 9.42 | 10.83 |
| 1986 | 0.45 | 0.69 | 1.00 | 1.50 | 2.09 | 2.98 | 3.85 | 5.25 | 6.10 | 7.30 | 7.60 | 10.81 |
| 1987 | 0.46 | 0.64 | 0.95 | 1.39 | 2.06 | 2.71 | 3.69 | 4.69 | 5.84 | 6.57 | 7.86 | 8.19 |
| 1988 | 0.56 | 0.68 | 0.92 | 1.42 | 1.88 | 2.60 | 3.29 | 4.64 | 5.35 | 6.40 | 7.22 | 7.95 |
| 1989 | 0.54 | 0.71 | 0.98 | 1.33 | 1.94 | 2.70 | 3.46 | 4.31 | 5.60 | 6.40 | 7.15 | 8.07 |
| 1990 | 0.51 | 0.74 | 1.01 | 1.46 | 2.00 | 2.60 | 3.77 | 4.57 | 5.74 | 6.91 | 7.79 | 8.96 |
| 1991 | 0.56 | 0.66 | 1.00 | 1.49 | 2.09 | 2.67 | 3.33 | 4.22 | 5.68 | 6.98 | 8.10 | 8.99 |
| 1992 | 0.38 | 0.65 | 0.88 | 1.35 | 1.97 | 2.62 | 3.47 | 4.52 | 5.21 | 7.04 | 8.94 | 10.13 |
| 1993 | 0.23 | 0.56 | 0.86 | 1.24 | 1.82 | 2.51 | 3.54 | 4.22 | 5.09 | 6.94 | 7.32 | 9.25 |
| 1994 | 0.53 | 0.54 | 0.94 | 1.42 | 1.74 | 2.42 | 3.19 | 4.36 | 5.20 | 6.03 | 7.13 | 7.43 |
| 1995 | 0.38 | 0.72 | 1.13 | 1.63 | 2.14 | 2.39 | 3.08 | 3.93 | 4.32 | 5.12 | 6.59 | 7.92 |
| 1996 | 0.58 | 0.72 | 1.12 | 1.79 | 2.26 | 2.70 | 3.00 | 3.73 | 4.55 | 4.47 | 5.49 | 7.45 |
| 1997 | 0.48 | 0.78 | 1.13 | 1.67 | 2.27 | 2.86 | 3.20 | 3.37 | 4.30 | 5.54 | 6.34 | 8.83 |
| 1998 | 0.51 | 0.79 | 1.19 | 1.63 | 2.13 | 2.79 | 3.62 | 3.79 | 4.03 | 4.89 | 6.38 | 9.12 |
| 1999 | 0.62 | 0.76 | 1.27 | 1.90 | 2.28 | 2.61 | 3.49 | 4.64 | 4.54 | 4.93 | 5.66 | 6.82 |
| 2000 | 0.51 | 0.79 | 1.12 | 1.80 | 2.52 | 2.67 | 2.98 | 4.25 | 5.90 | 5.53 | 5.82 | 6.89 |
| 2001 | 0.44 | 0.75 | 1.14 | 1.57 | 2.19 | 2.78 | 2.94 | 3.31 | 4.68 | 7.06 | 6.57 | 7.20 |

Table 8. Standardized gillnet (5.5 in mesh) and line-trawl catch rate-at-age indices estimated using data from sentinel fishery fixed sites. Catch rates are fish per net for gillnets and fish per 1000 hooks for line-trawl.

| **Gillnet Year/Age** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **Total** |
|---|---|---|---|---|---|---|---|---|---|
| **1995** | 0.018 | 0.087 | 4.375 | 9.303 | 5.401 | 2.572 | 0.354 | 0.130 | 22.241 |
| **1996** | 0.019 | 0.264 | 2.640 | 11.709 | 9.590 | 2.735 | 0.744 | 0.060 | 27.761 |
| **1997** | 0.009 | 0.243 | 5.034 | 4.652 | 7.794 | 7.372 | 0.868 | 0.683 | 26.656 |
| **1998** | 0.007 | 0.041 | 0.820 | 5.584 | 2.682 | 1.923 | 1.186 | 0.248 | 12.492 |
| **1999** | 0.000 | 0.013 | 1.164 | 1.654 | 2.197 | 0.741 | 0.212 | 0.198 | 6.179 |
| **2000** | 0.005 | 0.022 | 0.301 | 0.701 | 0.712 | 0.953 | 0.334 | 0.115 | 3.142 |

| **Linetrawl Year/Age** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **Total** |
|---|---|---|---|---|---|---|---|---|---|
| **1995** | 10.017 | 18.900 | 61.044 | 84.761 | 22.008 | 16.572 | 3.123 | 1.267 | 217.690 |
| **1996** | 9.068 | 32.961 | 31.343 | 50.100 | 51.718 | 14.336 | 8.052 | 1.806 | 199.385 |
| **1997** | 6.531 | 26.672 | 26.576 | 17.652 | 16.553 | 23.730 | 2.198 | 1.714 | 121.627 |
| **1998** | 10.214 | 22.218 | 25.588 | 20.165 | 7.371 | 11.162 | 13.268 | 2.211 | 112.196 |
| **1999** | 11.045 | 22.090 | 26.753 | 19.881 | 8.590 | 6.627 | 4.663 | 1.473 | 101.122 |
| **2000** | 16.772 | 37.819 | 31.435 | 25.050 | 13.688 | 9.739 | 3.896 | 0.812 | 139.210 |

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Table 9. Cod abundance estimates (000's ) from DFO bottom-trawl research vessel surveys in NAFO Subdiv. 3Ps. Shaded cells are model estimates. See Fig. 11 for locations of strata.

| Depth range (fathoms) | Strata | Vessel | AN | AN | WT | WT | WT | WT | WT | WT | WT | WT | WT | WT | WT | WT | WT | WT | WT | WT | WT | WT, Tel |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Trips | 9 | 28 | 28 | 45 | 56+58 | 68 | 81 | 91 | 103 | 118 | 133 | 135 | 150-161 | 166-167 | 186-187 | 202-203 | 219-220 | 236-237 | 313-315 | 34-365, 361 |
| | | Sets | 164 | 93 | 108 | 136 | 130 | 140 | 148 | 108 | 108 | 137 | 136 | 130 | 166 | 161 | 148 | 158 | 176 | 176 | 171 | 173 |
| | | Mean Date | 30-Apr | 13-Apr | 13-Mar | 16-Mar | 7-Mar | 5-Feb | 9-Feb | 9-Feb | 10-Feb | 14-Feb | 13-Feb | 11-Apr | 18-Apr | 16-Apr | 22-Apr | 12-Apr-97 | 21-Apr | 24-Apr | 21-Apr | 18-Apr |
| | | sq. mi. | 1983 | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 | 1991 | 1992 | 1993W | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 |
| <30 | 314 | 874 | 2527 | 134 | 86 | 0 | 0 | 211 | 30 | 45 | 0 | 0 | 0 | 0 | 74 | 0 | 0 | 77 | 67 | 1729 | 1631 | 153 |
| | 320 | 1320 | 3424 | 3473 | 1089 | 262 | 248 | 303 | 853 | 0 | 620 | 20 | 0 | 0 | 0 | 0 | 546 | 303 | 1292 | 3646 | 6183 | 1643 |
| 31-60 | 293 [5] | 159 | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | 107 | 292 | 601 | 394 | 219 |
| | 308 | 112 | 627 | 801 | 1741 | 0 | 169 | 247 | 16 | 77 | 31 | 62 | 39 | 308 | 701 | 223 | 177 | 262 | 4176 | 2704 | 1929 | 1094 |
| | 312 | 272 | 6096 | 374 | 8026 | 56 | 318 | 580 | 62 | 0 | 56 | 0 | 37 | 0 | 0 | 87 | 37 | 19 | 100 | 461 | 1236 | 636 |
| | 315 | 827 | 1536 | 1163 | 1963 | 2920 | 483 | 190 | 228 | 87 | 439 | 33 | 0 | 0 | 0 | 0 | 1387 | 38 | 6721 | 2429 | 1996 | 1040 |
| | 321 | 1189 | 2355 | 954 | 210 | 82 | 887 | 238 | 38 | 102 | 636 | 0 | 0 | 20 | 0 | 0 | 345 | 19 | 49 | 894 | 1161 | 56 |
| | 325 | 944 | 688 | 312 | 0 | 81 | 152 | 43 | 148 | 130 | 1088 | 466 | 14 | 0 | 0 | 0 | 103 | 109 | 16 | 752 | 2824 | 1526 |
| | 326 | 166 | 99 | 0 | [illegible] | 0 | 69 | 80 | 0 | 34 | 69 | 0 | 46 | 0 | 0 | 194 | 11 | 0 | 11 | 52 | 109 | 57 |
| | 783 [1] | 229 | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | 0 | nf | nf | 47 | 16 | 110 | 98 | 142 |
| 51-100 | 294 [5] | 136 | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | 178 | 901 | 382 | 170 | 195 |
| | 297 [5] | 152 | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | 408 | 209 | 1892 | 7000 | 480 |
| | 307 | 385 | 1843 | 380 | 4347 | 16460 | 3696 | 8803 | 8824 | 2717 | 797 | 869 | 353 | 2626 | 12769 | 1087 | 1646 | 1123 | 23490 | 5879 | 6981 | 5865 |
| | 311 | 317 | 7907 | 1090 | 14868 | 3183 | 16905 | 17236 | 1899 | 2369 | 1134 | 218 | 146 | 392 | 2582 | 116 | 654 | 371 | 1652 | 2109 | 2994 | 610 |
| | 317 | 163 | 8266 | 27 | 8190 | 4809 | 3487 | 2895 | 2363 | 226 | 1978 | 531 | 0 | 158 | 0 | 465 | 1195 | 451 | 173 | 306 | 1487 | 637 |
| | 319 | 894 | 16321 | 4829 | 338 | 9626 | 26403 | 17256 | 6869 | [illegible] | 25764 | 2083 | 647 | 3023 | 160 | 575 | 11477 | 1089 | 15600 | 11839 | 8327 | 59896 |
| | 322 | 1587 | 8936 | 2894 | 10297 | 11946 | 9140 | 6030 | 7760 | 3746 | 5758 | 81 | 0 | 0 | 431 | 0 | 654 | 234 | 260 | 713 | 1529 | 413 |
| | 323 | 686 | 3606 | 3679 | 6630 | 8866 | 10627 | 4040 | 2134 | 120 | 2011 | 16 | 0 | 0 | 0 | 0 | 82 | 24 | 32 | 159 | 1001 | 941 |
| | 324 | 494 | 8665 | 7203 | 30157 | 720 | 1087 | 2395 | 0 | 353 | 2833 | 163 | 0 | 0 | 544 | 86 | 91 | 272 | 160 | 361 | 442 | 85 |
| | 781 [1] | 446 | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | 0 | 307 | 280 | 195 | 276 | 1058 | 718 | 1584 |
| | 782 [1] | 183 | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | 302 | 0 | nf | 63 | 38 | 38 | 315 | 78 |
| 101-150 | 295 [5] | 209 | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | 169 | 486 | 976 | 615 | 878 |
| | 298 [5] | 171 | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | 110 | 1861 | 48 | 3450 | 670 |
| | 300 [6] | 217 | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | 584 | 1579 | 641 | 898 | 791 |
| | 308 | 383 | 2110 | 75 | 574 | [illegible] | 3846 | 2422 | 1285 | 8273 | 982 | 1118 | 386 | 2659 | 1273 | 350 | 1106 | 816 | 771 | 709 | 4191 | 949 |
| | 309 | 296 | 837 | 122 | 2484 | 4822 | 2443 | 3461 | 1771 | 3786 | 3122 | 244 | 95 | 1853 | 244 | 421 | 6190 | 260 | 11980 | 216 | 142 | 2066 |
| | 310 | 170 | 133 | 94 | 203 | 361 | 304 | 898 | 6443 | 3414 | 13423 | 175 | 82 | 748 | 405 | 388 | 421 | 1360 | 105 | 131 | 187 | 508 |
| | 313 | 165 | 68 | 23 | 238 | 0 | 409 | 136 | 2054 | 908 | 6896 | 2962 | 11 | 238 | 68 | 1124 | 182 | 0 | 454 | 91 | 113 | 3584 |
| | 316 | 189 | 240 | 117 | 78 | 26 | 78 | 87 | 1586 | 20889 | 3081 | 104 | | 147 | 182 | 182 | 26 | 65 | 104 | 23 | 13 | 28 |
| | 318 | 129 | 6 | 0 | [illegible] | 27 | 710 | 18 | 4924 | [illegible] | 8856 | 6000 | 6061 | 2103 | 0 | 95666 | 630 | 1891 | 53 | 0 | 231 | 44 |
| | 779 [1] | 422 | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | 248 | 0 | 0 | 0 | 39 | 0 | 73 | 26 |
| | 780 [1] | 403 | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | 0 | 0 | nf | 35 | 10 | 0 | 40 | 0 |
| 161-200 | 296 [5] | 71 | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | 632 | 4 | 375 | 107 | 1824 |
| | 299 [6] | 212 | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | 643 | 49 | 0 | 13 | 131 |
| | 705 | 195 | 9 | 0 | 563 | 791 | 256 | 644 | 94 | 107 | 134 | 161 | 80 | 939 | 528 | 1113 | 418 | 241 | 378 | 24 | 54 | 83 |
| | 706 | 476 | 13 | 0 | 1097 | 557 | 9836 | 861 | 49 | 98 | 49 | 445 | 109 | 327 | 327 | 442 | 383 | 172 | 327 | 87 | 49 | 49 |
| | 707 | 74 | 3 | 0 | [illegible] | 580 | 753 | 1919 | 122 | [illegible] | 2682 | 1323 | 1817 | 494 | 219 | 448 | 2912 | 353 | 102 | 9 | 0 | 293 |
| | 715 | 129 | 158 | 44 | [illegible] | 1836 | 843 | 3724 | 167 | 2509 | 20768 | 2386 | 309 | 1749 | 2249 | 414 | 4117 | 516 | 5874 | 484 | 751 | 3013 |
| | 716 | 539 | 167 | 25 | 371 | 7866 | 2769 | 3470 | 704 | 693 | 1216 | 3879 | 463 | 204 | 519 | 678 | 1764 | 91 | 3089 | 2429 | 199 | 99 |
| 201-300 | 708 | 126 | 0 | 0 | [illegible] | 461 | 14317 | 14490 | 113 | 1410 | 537 | 1300 | 813 | 1621 | 16842 | 2806 | 208 | 386 | 1484 | 947 | 0 | 35 |
| | 711 | 583 | 20 | 0 | 33 | 8227 | 392 | 387 | 219 | 544 | 9306 | 603 | 176 | 0 | 41 | 20 | 77 | 44 | 16 | 0 | 783 | 80 |
| | 712 | 731 | 0 | [illegible] | 620 | 419 | 67 | 536 | 141 | 1931 | 1730 | 716 | 1099 | 302 | 369 | 322 | 101 | 80 | 201 | 50 | 98 | 117 |
| | 713 | 851 | 33 | [illegible] | 117 | 117 | 1463 | 369 | 843 | 20233 | 8861 | 1806 | 2819 | 234 | 1405 | 893 | 862 | 801 | 61 | 78 | 176 | 364 |
| | 714 | 1074 | 43 | [illegible] | [illegible] | 836 | 386 | 906 | 4763 | 20896 | 32838 | 15431 | 12120 | 1440 | 2429 | 2896 | 750 | 2785 | 485 | 173 | 151 | 3781 |
| 301-400 | 709 [2] | 147 | 0 | 0 | 0 | 0 | nf | 30 | 10 | nf | 40 | nf | 4568 | 1087 | nf | 101 | 0 | nf | 0 | 0 | 10 | 30 |
| 401-500 | 710 [1] | 158 | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | 32 | nf | nf | nf | nf | 0 | nf | nf |
| 501-600 | 776 [1] | 159 | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf |
| 601-700 | 777 [1] | 183 | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf |
| 701-800 | 778 [1] | 169 | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf |
| | Total [3] | | 77,124 | 20,213 | 116,546 | 86,236 | 111,219 | 83,723 | 51,885 | 104,745 | 155,522 | 43,882 | 26,713 | 21,786 | 43,330 | 110,886 | 40,250 | 16,122 | 78,250 | 38,438 | 46,543 | 88,209 |
| | Total [4] | | 77,124 | 20,213 | 116,546 | 86,236 | 111,219 | 83,753 | 51,885 | 104,745 | 155,582 | 43,882 | 31,269 | 22,872 | 43,912 | 111,383 | 40,530 | 18,290 | 83,867 | 46,537 | 60,428 | 95,405 |
| | upper | | 107,186 | 63,111 | 618,003 | 128,603 | 169,379 | 153,608 | 79,714 | 177,819 | 240,890 | 84,676 | 48,866 | 29,686 | 72,419 | 1,325,621 | 64,189 | 21,385 | 168,891 | 56,198 | 60749 | 147318 |
| | t-value | | 2.12 | 3.18 | 12.71 | 2.26 | 2.45 | 3.18 | 3.18 | 2.78 | 2.57 | 2.45 | 3.18 | 2.31 | 2.78 | 12.71 | 2.45 | 2.31 | 3.182 | 2.23 | 2.20 | 2.36 |
| | std [6] | | 14,190 | 7,615 | 38,486 | 17,801 | 23,767 | 18,831 | 8,746 | 26,286 | 33,139 | 8,487 | 7,273 | 3,377 | 10,484 | 85,588 | 8,771 | 2,793 | 27,867 | 7,086 | 8,457 | 25,046 |

[1] These strata were added to the stratification scheme in 1994.

[2] Strata 709 was redrawn in 1994 and includes the area covered by strata 710 in previous surveys. All sets done in 710 prior to 1994 have been recoded to 709.

[3] For index strata 0-300 fathoms in the offshore and includes estimates (shaded cells) for non-sampled strata.

[4] totals are for all strata fished.

[5] These strata were added to the stratification scheme in 1997.

[6] std's are for index strata and do not include estimates from non-sampled strata.

Table 9. Cod abundance estimates (000's ) from DFO bottom-trawl research vessel surveys in NAFO Subdiv. 3Ps. Shaded cells are model estimates. See Fig. 11 for locations of strata.

| | | Vessel | AN | AN | WT | WT | WT | WT | WT | WT | WT | WT | WT | WT | WT | WT | WT | WT | WT | WT | WT | WT, Tel |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Trips | 8 | 28 | 28 | 45 | 56+66 | 69 | 81 | 91 | 103 | 118 | 133 | 135 | 150-151 | 166-167 | 186-187 | 202-203 | 219-220 | 236-237 | 313-315 | 34-385, 361 |
| | | Sets | 164 | 93 | 109 | 138 | 130 | 146 | 140 | 108 | 158 | 137 | 136 | 130 | 166 | 161 | 148 | 158 | 178 | 176 | 171 | 173 |
| | | Mean Date | 30-Apr | 13-Apr | 13-Mar | 15-Mar | 7-Mar | 5-Feb | 9-Feb | 9-Feb | 10-Feb | 14-Feb | 13-Feb | 11-Apr | 16-Apr | 19-Apr | 22-Apr | 12-Apr-97 | 21-Apr | 24-Apr | 21-Apr | 18-Apr |
| Depth range (fathoms) | Strata | sq. mi. | 1983 | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 | 1991 | 1992 | 1993W | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 |
| <30 | 314 | 874 | 2627 | 134 | 98 | 0 | 0 | 211 | 30 | 45 | 0 | 0 | 0 | 0 | 74 | 0 | 0 | 77 | 87 | 1729 | 1531 | 153 |
| | 320 | 1320 | 3424 | 3473 | 1089 | 202 | 248 | 343 | 853 | 0 | 620 | 20 | 0 | 0 | 0 | 0 | 645 | 303 | 1282 | 3848 | 5183 | 1843 |
| 31-50 | 293[5] | 168 | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | 107 | 282 | 601 | 384 | 219 |
| | 308 | 112 | 627 | 801 | 1741 | 0 | 169 | 247 | 16 | 77 | 31 | 62 | 38 | 308 | 701 | 223 | 177 | 262 | 4176 | 2704 | 1829 | 1064 |
| | 312 | 272 | 6098 | 374 | 8028 | 56 | 318 | 680 | 62 | 0 | 56 | 0 | 37 | 0 | 0 | 87 | 37 | 19 | 100 | 481 | 1236 | 636 |
| | 315 | 827 | 1636 | 1183 | 1983 | 2820 | 483 | 190 | 229 | 87 | 439 | 33 | 0 | 0 | 0 | 0 | 1387 | 38 | 6721 | 2429 | 1898 | 1040 |
| | 321 | 1189 | 2366 | 864 | 210 | 82 | 867 | 238 | 38 | 102 | 635 | 0 | 0 | 20 | 0 | 0 | 345 | 18 | 48 | 894 | 1161 | 56 |
| | 325 | 944 | 696 | 312 | 0 | 81 | 162 | 43 | 148 | 130 | 1088 | 485 | 14 | 0 | 0 | 0 | 103 | 108 | 16 | 752 | 2824 | 1528 |
| | 328 | 186 | 99 | 0 | [illegible] | 0 | 68 | 80 | 0 | 34 | 66 | 0 | 48 | 0 | 0 | 194 | 11 | 0 | 11 | 52 | 109 | 87 |
| | 783[1] | 229 | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | 0 | nf | nf | 47 | 18 | 110 | 98 | 142 |
| 51-100 | 294[5] | 136 | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | 178 | 801 | 382 | 170 | 195 |
| | 297[5] | 162 | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | 408 | 209 | 1892 | 7000 | 460 |
| | 307 | 386 | 1943 | 380 | 4347 | 15460 | 3686 | 8803 | 6824 | 2717 | 787 | 869 | 363 | 2826 | 12769 | 1087 | 1646 | 1123 | 23480 | 6879 | 6691 | 6095 |
| | 311 | 317 | 7907 | 1090 | 14868 | 3183 | 16905 | 17236 | 1699 | 2369 | 1134 | 218 | 145 | 382 | 2562 | 116 | 684 | 371 | 1652 | 2169 | 2984 | 610 |
| | 317 | 183 | 8268 | 27 | 8190 | 4898 | 3487 | 2895 | 2363 | 226 | 1978 | 531 | 0 | 169 | 0 | 485 | 1185 | 451 | 173 | 305 | 1487 | 637 |
| | 319 | 984 | 16321 | 4829 | 338 | 8526 | 25403 | 17258 | 6968 | [illegible] | 26784 | 2893 | 847 | 3023 | 150 | 575 | 11477 | 1869 | 18600 | 11839 | 8327 | 58696 |
| | 322 | 1587 | 8938 | 2694 | 10297 | 11848 | 8140 | 5030 | 7790 | 3746 | 6768 | 81 | 0 | 0 | 431 | 0 | 564 | 234 | 290 | 713 | 1629 | 413 |
| | 323 | 606 | 3606 | 3878 | 6830 | 6899 | 10827 | 4040 | 2134 | 120 | 2011 | 16 | 0 | 0 | 0 | 0 | 92 | 24 | 32 | 158 | 1001 | 841 |
| | 324 | 484 | 8896 | 7203 | 38167 | 720 | 1097 | 2395 | 0 | 353 | 2033 | 163 | 0 | 0 | 644 | 95 | 91 | 272 | 180 | 361 | 442 | 85 |
| | 781[1] | 448 | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | 0 | 307 | 280 | 186 | 278 | 1058 | 716 | 1584 |
| | 782[1] | 183 | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | 302 | 0 | nf | 63 | 38 | 38 | 315 | 78 |
| 101-150 | 296[5] | 209 | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | 189 | 465 | 878 | 615 | 878 |
| | 298[5] | 171 | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | 110 | 1661 | 48 | 3450 | 670 |
| | 300[5] | 217 | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | 684 | 1579 | 641 | 898 | 791 |
| | 306 | 363 | 2110 | 76 | 674 | [illegible] | 3846 | 2422 | 1286 | 8273 | 982 | [illegible] | 399 | 2959 | 1273 | 350 | 1106 | 816 | 771 | 709 | 4191 | 949 |
| | 309 | 296 | 937 | 122 | 2484 | 4822 | 2443 | 3461 | 1771 | 3788 | 3122 | 244 | 95 | 1863 | 244 | 421 | 8180 | 260 | 11980 | 218 | 142 | 2056 |
| | 310 | 170 | 133 | 94 | 203 | 361 | 304 | 898 | 6443 | 3414 | 13423 | 176 | 82 | 749 | 406 | 399 | 421 | 1380 | 106 | 131 | 187 | 608 |
| | 313 | 165 | 88 | 23 | 238 | 0 | 409 | 136 | 2064 | 906 | 6806 | 2962 | 11 | 238 | 69 | 1124 | 182 | 0 | 484 | 91 | 113 | 3584 |
| | 316 | 189 | 240 | 117 | 78 | 28 | 78 | 87 | 1686 | 20669 | 3091 | 104 | | 147 | 182 | 182 | 28 | 66 | 104 | 23 | 13 | 28 |
| | 318 | 129 | 6 | 0 | [illegible] | 27 | 710 | 18 | 4924 | [illegible] | 6866 | 6900 | 3051 | 2103 | 0 | 95658 | 630 | 1661 | 53 | 0 | 231 | 44 |
| | 779[1] | 422 | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | 248 | 0 | 0 | 0 | 39 | 0 | 73 | 28 |
| | 780[1] | 403 | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | 0 | 0 | nf | 35 | 18 | 0 | 40 | 0 |
| 151-200 | 290[5] | 71 | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | 632 | 4 | 375 | 107 | 1824 |
| | 299[5] | 212 | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | 643 | 49 | 0 | 13 | 131 |
| | 705 | 186 | 9 | 0 | 563 | 781 | 255 | 644 | 94 | 107 | 134 | 161 | 80 | 838 | 628 | 1113 | 418 | 241 | 378 | 24 | 54 | 83 |
| | 706 | 476 | 13 | 0 | 1097 | 557 | 9835 | 861 | 49 | 98 | 49 | 445 | 108 | 327 | 327 | 442 | 393 | 172 | 327 | 87 | 48 | 48 |
| | 707 | 74 | 3 | 0 | [illegible] | 680 | 753 | 1819 | 122 | [illegible] | 2682 | 1323 | 1817 | 484 | 218 | 448 | 2812 | 353 | 102 | 9 | 0 | 293 |
| | 715 | 128 | 158 | 44 | [illegible] | 1638 | 843 | 3724 | 187 | 2608 | 20768 | 2389 | 309 | 1749 | 2249 | 414 | 4117 | 618 | 6874 | 484 | 761 | 3013 |
| | 716 | 639 | 187 | 26 | 371 | 7856 | 2769 | 3470 | 704 | 583 | 1216 | 3879 | 463 | 204 | 619 | 579 | 1794 | 91 | 3089 | 2428 | 199 | 98 |
| 201-300 | 708 | 126 | 0 | 0 | [illegible] | 461 | 14317 | 14490 | 113 | 1410 | 637 | 1300 | 613 | 1621 | 16842 | 2909 | 209 | 389 | 1464 | 947 | 0 | 36 |
| | 711 | 593 | 20 | 0 | 33 | 8227 | 382 | 387 | 218 | 544 | 9395 | 603 | 178 | 0 | 41 | 20 | 77 | 44 | 18 | 0 | 780 | 80 |
| | 712 | 731 | 0 | 117 | 620 | 418 | 67 | 538 | 141 | 1831 | 1730 | 716 | 1099 | 302 | 389 | 322 | 101 | 90 | 201 | 50 | 89 | 117 |
| | 713 | 861 | 33 | [illegible] | 117 | 117 | 1463 | 369 | 843 | 20233 | 6951 | 1806 | 2919 | 234 | 1405 | 893 | 852 | 901 | 61 | 78 | 178 | 364 |
| | 714 | 1074 | 43 | [illegible] | [illegible] | 835 | 398 | 805 | 4753 | 20898 | 32839 | 16431 | 12120 | 1440 | 2429 | 2999 | 750 | 2795 | 486 | 173 | 161 | 3781 |
| 301-400 | 709[2] | 147 | 0 | 0 | 0 | 0 | nf | 30 | 10 | nf | 40 | nf | 4568 | 1087 | nf | 101 | 0 | nf | 0 | 0 | 10 | 30 |
| 401-500 | 710[1] | 156 | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | 33 | nf | nf | nf | nf | 0 | nf | nf |
| 501-600 | 776[1] | 159 | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf |
| 601-700 | 777[1] | 193 | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf |
| 701-800 | 778[1] | 166 | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf |
| | Total[3] | | 77,124 | 28,213 | 116,548 | 89,238 | 111,219 | 83,723 | 51,895 | 104,745 | 155,622 | 43,892 | 28,713 | 21,795 | 43,330 | 110,895 | 40,250 | 15,122 | 78,250 | 30,439 | 49,843 | 88,209 |
| | Total[4] | | 77,124 | 28,213 | 116,548 | 89,238 | 111,219 | 83,753 | 51,895 | 104,745 | 155,882 | 43,892 | 31,289 | 22,872 | 43,912 | 111,383 | 40,530 | 18,290 | 83,997 | 45,537 | 60,429 | 96,406 |
| | upper | | 107,165 | 63,111 | 618,003 | 128,603 | 169,378 | 153,606 | 79,714 | 177,819 | 240,890 | 64,676 | 49,898 | 29,698 | 72,418 | 1,326,621 | 64,108 | 21,398 | 168,891 | 56,198 | 80748 | 147318 |
| | t-value | | 2.12 | 3.18 | 12.71 | 2.26 | 2.45 | 3.18 | 3.18 | 2.78 | 2.57 | 2.45 | 3.18 | 2.31 | 2.78 | 12.71 | 2.45 | 2.31 | 3.182 | 2.23 | 2.20 | 2.30 |
| | sd[6] | | 14,180 | 7,615 | 38,496 | 17,801 | 23,767 | 18,631 | 8,746 | 26,298 | 33,139 | 8,487 | 7,273 | 3,377 | 10,464 | 96,559 | 8,771 | 2,703 | 27,957 | 7,066 | 8,457 | 25,046 |

[1] These strata were added to the stratification scheme in 1994.

[2] Strata 709 was redrawn in 1994 and includes the area covered by strata 710 in previous surveys. All sets done in 710 prior to 1994 have been recoded to 709.

[3] For index strata 0-300 fathoms in the offshore and includes estimates (shaded cells) for non-sampled strata .

[4] totals are for all strata fished .

[5] These strata were added to the stratification scheme in 1997.

[6] sd's are for index strata and do not include estimates from non-sampled strata.

Table 10. Cod biomass estimates (t) from DFO research vessel bottom-trawl surveys in NAFO Subdiv. 3Ps. Shaded cells are model estimates. See Fig. 11 for location of strata.

| Depth range (fathoms) | Strata | Vessel<br>Trips<br>Sets<br>Mean Dst<br>sq. mi. | AN<br>9<br>164<br>30-Apr<br>1983 | AN<br>26<br>93<br>13-Apr<br>1984 | WT<br>26<br>109<br>13-Mar<br>1985 | WT<br>46<br>136<br>15-Mar<br>1986 | WT<br>56+58<br>130<br>7-Mar<br>1987 | WT<br>68<br>146<br>5-Feb<br>1988 | WT<br>81<br>146<br>9-Feb<br>1989 | WT<br>91<br>109<br>9-Feb<br>1990 | WT<br>103<br>158<br>10-Feb<br>1991 | WT<br>118<br>137<br>14-Feb<br>1992 | WT<br>133<br>136<br>13-Feb<br>1993W | WT<br>135<br>130<br>11-Apr<br>1993 | WT<br>150-151<br>166<br>15-Apr<br>1994 | WT<br>166-167<br>161<br>16-Apr<br>1995 | WT<br>186-187<br>148<br>22-Apr<br>1996 | WT<br>202-203<br>168<br>12-Apr<br>1997 | WT<br>219-220<br>178<br>21-Apr<br>1998 | WT<br>236-237<br>175<br>24-Apr<br>1999 | WT<br>313-315<br>171<br>21-Apr<br>2000 | WT, Tel<br>304-305, 361<br>173<br>18-Apr<br>2001 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| <30 | 314 | 974 | 15836 | 733 | 56 | 0 | 0 | 104 | 20 | 240 | 0 | 0 | 0 | 0 | 212 | 0 | 0 | 32 | 6 | 595 | 829 | 46 |
|  | 320 | 1320 | 8914 | 8700 | 6971 | 404 | 700 | 2299 | 1683 | 0 | 267 | 52 | 0 | 0 | 0 | 0 | 155 | 114 | 7766 | 6287 | 6761 | 601 |
| 31-60 | 283[5] | 159 | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | 17 | 19 | 27 | 45 | 28 |
|  | 308 | 112 | 1371 | 1157 | 1809 | 0 | 27 | 17 | 8 | 19 | 10 | 18 | 9 | 96 | 236 | 41 | 35 | 93 | 1461 | 1572 | 1089 | 184 |
|  | 312 | 272 | 1179 | 1090 | 3891 | 110 | 102 | 25 | 14 | 0 | 23 | 0 | 28 | 0 | 0 | 13 | 4 | 13 | 8 | 226 | 840 | 93 |
|  | 315 | 827 | 4143 | 2586 | 661 | 4606 | 1211 | 1992 | 2453 | 129 | 614 | 39 | 0 | 0 | 0 | 0 | 869 | 14 | 20072 | 3771 | 3092 | 491 |
|  | 321 | 1189 | 4121 | 1941 | 173 | 516 | 410 | 2201 | 506 | 24 | 146 | 0 | 0 | 37 | 0 | 0 | 8 | 2 | 0 | 1855 | 4582 | 2 |
|  | 325 | 844 | 671 | 915 | 0 | 66 | 265 | 53 | 38 | 84 | 248 | 42 | 184 | 0 | 0 | 0 | 173 | 10 | 0 | 416 | 1307 | 340 |
|  | 326 | 166 | 407 | 0 | [illegible] | 0 | 36 | 58 | 0 | 14 | 45 | 0 | 13 | 0 | 0 | 14 | 0 | 6 | 0 | 8 | 478 | 25 |
|  | 783[1] | 229 | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | 0 | nf | nf | 0 | 0 | 14 | 18 | 6 |
| 61-100 | 294[5] | 136 | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | 24 | 40 | 19 | 7 | 28 |
|  | 297[5] | 152 | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | 39 | 22 | 1697 | 2339 | 108 |
|  | 307 | 395 | 2017 | 1441 | 8454 | 19930 | 4938 | 21706 | 6118 | 1033 | 171 | 128 | 70 | 1677 | 8884 | 250 | 633 | 332 | 16164 | 3784 | 5162 | 1578 |
|  | 311 | 317 | 5706 | 1711 | 10098 | 703 | 8578 | 2484 | 755 | 265 | 112 | 25 | 15 | 100 | 593 | 35 | 64 | 51 | 169 | 3342 | 1661 | 28 |
|  | 317 | 193 | 7086 | 62 | 15789 | 3671 | 1867 | 362 | 486 | 18 | 756 | 73 | 0 | 244 | 0 | 40 | 73 | 62 | 196 | 36 | 259 | 331 |
|  | 319 | 984 | 6983 | 6099 | 1861 | 16211 | 18530 | 23773 | 14172 | [illegible] | 2438 | 382 | 82 | 507 | 32 | 208 | 12785 | 297 | 28144 | 18019 | 8121 | 61570 |
|  | 322 | 1567 | 9141 | 3804 | 2597 | 4671 | 3228 | 875 | 492 | 347 | 428 | 32 | 0 | 0 | 39 | 0 | 177 | 118 | 13 | 117 | 1893 | 193 |
|  | 323 | 696 | 1730 | 3835 | 2962 | 5790 | 21016 | 614 | 542 | 28 | 180 | 41 | 0 | 0 | 0 | 0 | 89 | 15 | 112 | 227 | 643 | 305 |
|  | 324 | 494 | 1790 | 787 | 24880 | 521 | 384 | 495 | 0 | 38 | 217 | 33 | 0 | 0 | 7 | 18 | 3 | 11 | 8 | 262 | 25 | 7 |
|  | 781[1] | 446 | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | 0 | 113 | 40 | 22 | 16 | 64 | 48 | 36 |
|  | 782[1] | 183 | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | 8 | 0 | nf | 2 | 7 | 1 | 7 | 0 |
| 101-150 | 295[5] | 209 | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | 24 | 139 | 45 | 61 | 124 |
|  | 298[5] | 171 | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | 42 | 2909 | 148 | 2632 | 202 |
|  | 300[5] | 217 | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | 147 | 802 | 650 | 307 | 153 |
|  | 306 | 383 | 2167 | 448 | 974 | [illegible] | 3315 | 4713 | 605 | 2796 | 149 | [illegible] | 114 | 1820 | 950 | 191 | 194 | 312 | 618 | 553 | 5123 | 543 |
|  | 309 | 298 | 1650 | 292 | 3306 | 5739 | 4613 | 5266 | 3154 | 3062 | 1168 | 50 | 15 | 2021 | 358 | 272 | 4922 | 87 | 9799 | 320 | 305 | 1118 |
|  | 310 | 170 | 293 | 209 | 503 | 604 | 393 | 992 | 812 | 938 | 880 | 40 | 13 | 378 | 374 | 229 | 124 | 206 | 72 | 146 | 330 | 499 |
|  | 313 | 165 | 159 | 242 | 481 | 0 | 583 | 155 | 1390 | 305 | 472 | 290 | 12 | 162 | 43 | 1279 | 259 | 0 | 481 | 162 | 97 | 18231 |
|  | 316 | 189 | 492 | 262 | 151 | 113 | 144 | 59 | 3839 | 13956 | 294 | 43 |  | 144 | 270 | 42 | 39 | 40 | 139 | 43 | 21 | 63 |
|  | 318 | 129 | 25 | 0 | [illegible] | 146 | 1369 | 196 | 17758 | [illegible] | 2339 | 1800 | 1709 | 1616 | 0 | 129689 | 1076 | 404 | 69 | 0 | 692 | 28 |
|  | 779[1] | 422 | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | 18 | 0 | 0 | 0 | 10 | 0 | 4 | 1 |
|  | 780[1] | 403 | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | 0 | 0 | nf | 3 | 1 | 0 | 6 | 0 |
| 151-200 | 296[5] | 71 | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | 175 | 1 | 102 | 20 | 341 |
|  | 299[5] | 212 | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | 282 | 231 | 0 | 1 | 411 |
|  | 705 | 195 | 55 | 0 | 904 | 1063 | 273 | 1053 | 52 | 236 | 16 | 67 | 47 | 1143 | 662 | 1827 | 663 | 476 | 346 | 25 | 20 | 71 |
|  | 706 | 476 | 72 | 0 | 3010 | 907 | 15334 | 1927 | 199 | 153 | 182 | 436 | 78 | 251 | 277 | 305 | 576 | 379 | 268 | 68 | 63 | 28 |
|  | 707 | 74 | 11 | 0 | [illegible] | 2779 | 1821 | 6963 | 411 | [illegible] | 1366 | 767 | 914 | 948 | 24 | 591 | 5409 | 72 | 121 | 21 | 0 | 360 |
|  | 715 | 128 | 589 | 99 | [illegible] | 2736 | 1315 | 7420 | 346 | 1061 | 17037 | 1929 | 347 | 1743 | 2802 | 575 | 3807 | 233 | 6849 | 1127 | 1240 | 5599 |
|  | 716 | 539 | 311 | 24 | 710 | 7731 | 3291 | 4722 | 779 | 1112 | 386 | 862 | 64 | 226 | 676 | 777 | 1487 | 44 | 1772 | 4106 | 229 | 82 |
| 201-300 | 708 | 126 | 0 | 0 | [illegible] | 690 | 18386 | 42342 | 123 | [illegible] | 1072 | 2419 | 369 | 1061 | 10036 | 5611 | 247 | 629 | 4389 | 1466 | 0 | 54 |
|  | 711 | 693 | 28 | 0 | 62 | 10825 | 569 | 841 | 745 | 496 | 23174 | 360 | 290 | 0 | 30 | 27 | 82 | 43 | 11 | 0 | 1242 | 76 |
|  | 712 | 731 | 0 | [illegible] | 1267 | 644 | 262 | 1042 | 207 | 1419 | 1523 | 1020 | 1306 | 243 | 819 | 372 | 118 | 151 | 207 | 25 | 84 | 66 |
|  | 713 | 851 | 61 | [illegible] | 154 | 544 | 2469 | 567 | 1096 | 30722 | 6295 | 2025 | 3263 | 374 | 1700 | 1545 | 1481 | 1101 | 48 | 143 | 123 | 273 |
|  | 714 | 1074 | 286 | [illegible] | [illegible] | 2748 | 473 | 1476 | 7310 | 30996 | 32948 | 18902 | 12987 | 1739 | 2529 | 4161 | 824 | 3471 | 725 | 166 | 123 | 4113 |
| 301-400 | 709[2] | 147 | 0 | 0 | 0 | 0 | nf | 116 | 52 | nf | 27 | nf | 2487 | 739 | nf | 121 | 0 | nf | 0 | 0 | 5 | 59 |
| 401-500 | 710[1] | 156 | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | 18 | nf | nf | nf | nf | 0 | nf | nf |
| 501-600 | 776[1] | 159 | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf |
| 601-700 | 777[1] | 183 | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf |
| 701-800 | 778[1] | 166 | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf |
| Total[3] |  |  | 77,499 | 42,838 | 123,054 | 98,611 | 115,746 | 136,422 | 66,327 | 94,399 | 94,926 | 32,214 | 21,934 | 16,240 | 31,941 | 148,191 | 36,442 | 8,802 | 100,100 | 48,867 | 46,111 | 86,991 |
| Total[4] |  |  | 77,499 | 42,838 | 123,054 | 98,611 | 115,746 | 136,540 | 66,379 | 94,399 | 94,952 | 32,214 | 24,391 | 16,970 | 31,994 | 148,425 | 36,482 | 9,579 | 103,966 | 51,024 | 51,610 | 88,484 |
| upper |  |  | 112007 | 50251 | 434252 | 140824 | 185889 | 678921 | 101515 | 170305 | 170481 | 46569 | 22297 | 22297 | 54349 | 1781842 | 54586 | 14193 | 180874 | 71,366 | 60,676 | 148,519 |
| t-value |  |  | 2.20 | 2.06 | 12.71 | 2.28 | 2.45 | 12.71 | 2.31 | 2.31 | 2.57 | 2.28 | 2.13 | 2.31 | 2.78 | 12.71 | 2.23 | 2.36 | 2.201 | 2.13 | 2.15 | 2.57 |
| sd[6] |  |  | 15,678 | 3,599 | 24,492 | 19,909 | 28,930 | 42,762 | 15,259 | 32,943 | 29,463 | 5,909 | 170 | 2,622 | 9,169 | 129,320 | 8,143 | 2,284 | 27,612 | 10,563 | 6,667 | 23,941 |

[1] These strata were added to the stratification scheme in 1994.

[2] Strata 709 was redrawn in 1994 and includes the area covered by strata 710 in previous surveys. All sets done in 710 prior to 1994 have been recoded to 709

[3] For index strata 0-300 fathoms in the offshore and includes estimates (shaded cells) for non-sampled strata.

[4] totals are for all strata fished.

[5] These strata were added to the stratification scheme in 1997

[6] sd's are for index strata and do not include estimates from non-sampled strata.

Table 10. Cod biomass estimates (t) from DFO research vessel bottom-trawl surveys in NAFO Subdiv. 3Ps. Shaded cells are model estimates. See Fig. 11 for location of strata.

|  |  | Vessel | AN | AN | WT | WT | WT | WT | WT | WT | WT | WT | WT | WT | WT | WT | WT | WT | WT | WT | WT | WT, Tel |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
|  |  | Trips | 9 | 29 | 28 | 46 | 56+58 | 69 | 81 | 91 | 103 | 118 | 133 | 135 | 150-151 | 166-167 | 186-187 | 202-203 | 218-220 | 236-237 | 313-316 | 364-366, 361 |
| Depth range |  | Sets | 184 | 83 | 100 | 138 | 130 | 148 | 148 | 109 | 168 | 137 | 136 | 130 | 106 | 151 | 148 | 158 | 178 | 175 | 171 | 173 |
| range |  | Mean Dat | 30-Apr | 13-Apr | 13-Mar | 15-Mar | 7-Mar | 5-Feb | 9-Feb | 8-Feb | 10-Feb | 14-Feb | 13-Feb | 11-Apr | 15-Apr | 18-Apr | 22-Apr | 12-Apr | 21-Apr | 24-Apr | 21-Apr | 18-Apr |
| (fathoms) | Strata | sq. mi. | 1983 | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 | 1991 | 1992 | 1993W | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 |
| <30 | 314 | 974 | 10838 | 733 | 68 | 0 | 0 | 104 | 20 | 340 | 0 | 0 | 0 | 0 | 212 | 0 | 0 | 32 | 8 | 595 | 629 | 48 |
|  | 320 | 1320 | 6914 | 8700 | 6871 | 484 | 700 | 2299 | 1993 | 0 | 207 | 52 | 0 | 0 | 0 | 0 | 155 | 114 | 7798 | 6287 | 6761 | 601 |
| 31-50 | 293 [5] | 159 | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | 17 | 18 | 27 | 46 | 26 |
|  | 309 | 112 | 1371 | 1167 | 1809 | 0 | 27 | 17 | 8 | 18 | 10 | 18 | 9 | 96 | 236 | 41 | 35 | 93 | 1481 | 1572 | 1098 | 184 |
|  | 312 | 272 | 1179 | 1080 | 3891 | 110 | 102 | 25 | 14 | 0 | 23 | 0 | 29 | 0 | 0 | 13 | 4 | 13 | 8 | 228 | 840 | 93 |
|  | 315 | 627 | 4143 | 2098 | 891 | 4808 | 1211 | 1882 | 2483 | 129 | 614 | 38 | 0 | 0 | 0 | 0 | 868 | 14 | 20072 | 3771 | 3082 | 491 |
|  | 321 | 1199 | 4121 | 1841 | 173 | 516 | 410 | 2201 | 506 | 24 | 148 | 0 | 0 | 37 | 0 | 0 | 8 | 2 | 0 | 1855 | 4582 | 2 |
|  | 325 | 844 | 871 | 918 | 0 | 88 | 255 | 83 | 38 | 84 | 248 | 42 | 184 | 0 | 0 | 0 | 173 | 10 | 0 | 418 | 1307 | 340 |
|  | 326 | 166 | 487 | 0 | [illegible] | 0 | 38 | 88 | 0 | 14 | 45 | 0 | 13 | 0 | 0 | 14 | 0 | 0 | 0 | 8 | 478 | 25 |
|  | 783 [1] | 229 | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | 0 | nf | nf | 0 | 0 | 14 | 15 | 8 |
| 51-100 | 294 [5] | 136 | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | 24 | 40 | 18 | 7 | 28 |
|  | 297 [5] | 152 | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | 38 | 22 | 1687 | 2338 | 108 |
|  | 307 | 395 | 2017 | 1441 | 8454 | 18830 | 4838 | 21708 | 6118 | 1033 | 171 | 128 | 70 | 1877 | 8984 | 250 | 833 | 332 | 18184 | 3784 | 5102 | 1578 |
|  | 311 | 317 | 5708 | 1711 | 10088 | 703 | 8578 | 2484 | 758 | 286 | 112 | 25 | 15 | 100 | 585 | 35 | 84 | 51 | 189 | 3342 | 1881 | 28 |
|  | 317 | 193 | 7086 | 62 | 15799 | 3571 | 1867 | 362 | 488 | 18 | 768 | 73 | 0 | 244 | 0 | 40 | 73 | 62 | 108 | 38 | 258 | 331 |
|  | 319 | 884 | 6983 | 6888 | 1861 | 16211 | 18530 | 23773 | 14172 | [illegible] | 2438 | 382 | 82 | 507 | 32 | 208 | 12786 | 287 | 28144 | 18019 | 8121 | 61570 |
|  | 322 | 1667 | 9141 | 3904 | 2567 | 4571 | 3228 | 875 | 492 | 347 | 428 | 32 | 0 | 0 | 38 | 0 | 177 | 118 | 13 | 117 | 1893 | 193 |
|  | 323 | 688 | 1730 | 3936 | 2882 | 5790 | 21016 | 614 | 882 | 28 | 180 | 41 | 0 | 0 | 0 | 0 | 88 | 16 | 112 | 227 | 643 | 306 |
|  | 324 | 484 | 1780 | 787 | 24880 | 521 | 384 | 456 | 0 | 38 | 217 | 33 | 0 | 0 | 7 | 18 | 3 | 11 | 8 | 252 | 25 | 7 |
|  | 781 [1] | 448 | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | 0 | 113 | 40 | 22 | 18 | 64 | 49 | 38 |
|  | 782 [1] | 183 | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | 8 | 0 | nf | 2 | 7 | 1 | 7 | 0 |
| 101-150 | 295 [5] | 209 | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | 24 | 130 | 45 | 61 | 124 |
|  | 298 [5] | 171 | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | 42 | 2808 | 148 | 2632 | 202 |
|  | 300 [5] | 217 | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | 147 | 802 | 880 | 307 | 183 |
|  | 308 | 383 | 2167 | 448 | 874 | [illegible] | 3315 | 4713 | 805 | 2786 | 149 | [illegible] | 114 | 1820 | 950 | 181 | 184 | 312 | 818 | 593 | 5123 | 543 |
|  | 309 | 288 | 1080 | 292 | 3305 | 5738 | 4513 | 5255 | 3154 | 3062 | 1168 | 50 | 15 | 2021 | 358 | 272 | 4822 | 87 | 8788 | 320 | 303 | 1118 |
|  | 310 | 170 | 283 | 209 | 503 | 804 | 383 | 882 | 812 | 538 | 880 | 40 | 13 | 379 | 374 | 229 | 124 | 206 | 72 | 145 | 330 | 488 |
|  | 313 | 165 | 188 | 242 | 481 | 0 | 583 | 156 | 1380 | 308 | 472 | 280 | 12 | 182 | 43 | 1279 | 259 | 0 | 481 | 182 | 97 | 18231 |
|  | 316 | 189 | 482 | 262 | 151 | 113 | 144 | 88 | 3838 | 13858 | 284 | 43 |  | 144 | 270 | 42 | 38 | 40 | 138 | 43 | 21 | 63 |
|  | 318 | 129 | 25 | 0 | [illegible] | 148 | 1388 | 198 | 17758 | [illegible] | 2338 | 1800 | 1709 | 1616 | 0 | 129889 | 1075 | 404 | 88 | 0 | 882 | 28 |
|  | 779 [1] | 422 | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | 16 | 0 | 0 | 0 | 10 | 0 | 4 | 1 |
|  | 780 [1] | 403 | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | 0 | 0 | nf | 3 | 1 | 0 | 8 | 0 |
| 151-200 | 296 [5] | 71 | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | 175 | 1 | 102 | 20 | 341 |
|  | 299 [5] | 212 | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | 282 | 231 | 0 | 1 | 411 |
|  | 705 | 185 | 55 | 0 | 804 | 1063 | 273 | 1053 | 82 | 236 | 18 | 87 | 47 | 1143 | 662 | 1827 | 863 | 478 | 348 | 25 | 20 | 71 |
|  | 706 | 475 | 72 | 0 | 3010 | 807 | 15334 | 1827 | 189 | 153 | 182 | 436 | 78 | 251 | 277 | 385 | 575 | 379 | 298 | 88 | 63 | 29 |
|  | 707 | 74 | 11 | 0 | [illegible] | 2779 | 1821 | 6983 | 411 | [illegible] | 1308 | 787 | 914 | 848 | 24 | 591 | 5408 | 72 | 121 | 21 | 0 | 360 |
|  | 715 | 128 | 589 | 88 | [illegible] | 2738 | 1315 | 7420 | 348 | 1081 | 17037 | 1928 | 347 | 1743 | 2002 | 675 | 3807 | 233 | 9849 | 1127 | 1240 | 6889 |
|  | 716 | 838 | 311 | 24 | 710 | 7731 | 3291 | 4722 | 779 | 1112 | 388 | 982 | 44 | 229 | 876 | 777 | 1487 | 44 | 1772 | 4108 | 229 | 82 |
| 201-300 | 708 | 126 | 0 | 0 | [illegible] | 880 | 18386 | 42342 | 123 | [illegible] | 1072 | 2418 | 388 | 1081 | 10038 | 8611 | 247 | 629 | 4389 | 1486 | 0 | 84 |
|  | 711 | 683 | 28 | 0 | 62 | 10826 | 668 | 841 | 745 | 486 | 23174 | 380 | 280 | 0 | 30 | 27 | 82 | 43 | 11 | 0 | 1242 | 78 |
|  | 712 | 731 | 0 | [illegible] | 1267 | 644 | 282 | 1042 | 207 | 1419 | 1523 | 1020 | 1306 | 243 | 819 | 372 | 118 | 151 | 267 | 25 | 84 | 85 |
|  | 713 | 851 | 61 | [illegible] | 154 | 544 | 2469 | 567 | 1096 | 30722 | 6295 | 2025 | 3283 | 374 | 1700 | 1545 | 1481 | 1101 | 48 | 143 | 123 | 273 |
|  | 714 | 1074 | 265 | [illegible] | [illegible] | 2748 | 473 | 1478 | 7310 | 30886 | 32948 | 18802 | 12887 | 1739 | 2628 | 4161 | 824 | 3471 | 726 | 156 | 123 | 4113 |
| 301-400 | 709 [2] | 147 | 0 | 0 | 0 | 0 | nf | 118 | 52 | nf | 27 | nf | 2487 | 738 | nf | 121 | 0 | nf | 0 | 0 | 8 | 89 |
| 401-500 | 710 [1] | 198 | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | 19 | nf | nf | nf | nf | 0 | nf | nf |
| 501-600 | 776 [1] | 189 | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf |
| 601-700 | 777 [1] | 193 | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf |
| 701-800 | 778 [1] | 199 | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf | nf |
|  | Total [3] |  | 77,499 | 42,938 | 123,054 | 98,611 | 115,748 | 136,422 | 98,327 | 94,388 | 84,825 | 32,214 | 21,934 | 16,240 | 31,841 | 148,181 | 38,442 | 8,802 | 100,100 | 48,857 | 48,111 | 88,881 |
|  | Total [4] |  | 77,499 | 42,938 | 123,084 | 98,611 | 115,748 | 136,540 | 98,379 | 94,388 | 84,852 | 32,214 | 24,391 | 16,970 | 31,884 | 148,428 | 38,482 | 8,879 | 103,888 | 51,624 | 51,610 | 88,484 |
|  | upper |  | 112087 | 80251 | 434252 | 149824 | 188880 | 678921 | 101515 | 170366 | 170481 | 48888 | 22297 | 22297 | 84348 | 1781842 | 54588 | 14185 | 180874 | 71,368 | 90,878 | 148,519 |
|  | t-value |  | 2.20 | 2.00 | 12.71 | 2.28 | 2.45 | 12.71 | 2.31 | 2.31 | 2.57 | 2.28 | 2.13 | 2.31 | 2.78 | 12.71 | 2.23 | 2.36 | 2.201 | 2.13 | 2.15 | 2.57 |
|  | sd [6] |  | 15,679 | 3,586 | 24,492 | 19,809 | 29,630 | 42,782 | 15,259 | 32,943 | 29,403 | 5,909 | 170 | 2,022 | 8,160 | 129,320 | 8,143 | 2,284 | 27,612 | 10,583 | 8,867 | 23,841 |

[1] These strata were added to the stratification scheme in 1994.

[2] Strata 709 was redrawn in 1994 and includes the area covered by strata 710 in previous surveys. All sets done in 710 prior to 1994 have been recoded to 709.

[3] For index strata 0-300 fathoms in the offshore and includes estimates (shaded cells) for non-sampled strata.

[4] totals are for all strata fished.

[5] These strata were added to the stratification scheme in 1997.

[6] sd's are for index strata and do not include estimates from non-sampled strata.

Table 11. Mean numbers per tow at age in Campelen units for the Canadian RV index for the period 1983 to 2001. Data are adjusted for missing strata. There were two surveys in 1993 (January and April). A minor correction has been made to the 1995 index.

| Age/Year | 1983 | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 | 1991 | 1992 | 1993.1 | 1993.2 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | (Jan) | (Apr) | | | | | | | | |
| 1 | 6.42 | 0.30 | 0.38 | 0.20 | 1.09 | 0.42 | 0.49 | 0.00 | 1.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.90 | 0.22 | 0.52 | 1.24 | 1.25 | 0.57 |
| 2 | 10.01 | 5.40 | 7.74 | 6.62 | 8.48 | 9.13 | 6.50 | 1.48 | 27.69 | 1.80 | 0.00 | 0.00 | 1.63 | 0.31 | 1.08 | 1.53 | 0.97 | 2.54 | 3.33 | 2.26 |
| 3 | 6.52 | 2.33 | 14.88 | 5.65 | 5.67 | 5.93 | 4.66 | 9.82 | 5.03 | 6.95 | 1.83 | 1.99 | 1.46 | 1.16 | 3.67 | 2.33 | 6.79 | 2.55 | 5.36 | 12.41 |
| 4 | 1.14 | 1.55 | 12.57 | 6.46 | 4.97 | 2.96 | 3.17 | 14.49 | 10.00 | 2.11 | 4.03 | 4.04 | 4.31 | 1.67 | 3.62 | 1.04 | 8.42 | 2.38 | 3.10 | 12.29 |
| 5 | 3.72 | 0.63 | 9.96 | 7.95 | 13.82 | 2.84 | 1.51 | 10.89 | 11.24 | 4.15 | 0.71 | 1.49 | 6.10 | 13.08 | 1.32 | 0.50 | 5.60 | 2.58 | 2.17 | 4.36 |
| 6 | 1.62 | 2.11 | 3.28 | 6.33 | 8.31 | 6.50 | 1.16 | 5.67 | 5.75 | 2.03 | 2.96 | 1.35 | 1.73 | 19.65 | 2.69 | 0.28 | 3.99 | 2.34 | 1.82 | 2.04 |
| 7 | 0.48 | 0.77 | 2.66 | 2.13 | 3.35 | 5.84 | 2.15 | 3.84 | 2.84 | 1.03 | 0.68 | 0.47 | 1.62 | 4.40 | 2.91 | 0.30 | 1.96 | 1.72 | 1.20 | 1.26 |
| 8 | 0.89 | 0.37 | 0.79 | 1.47 | 1.29 | 3.65 | 1.21 | 3.14 | 1.58 | 0.53 | 0.33 | 0.10 | 0.50 | 5.75 | 0.54 | 0.24 | 2.50 | 0.44 | 0.89 | 0.77 |
| 9 | 1.61 | 0.46 | 0.48 | 0.84 | 0.69 | 1.49 | 0.67 | 1.15 | 1.19 | 0.26 | 0.13 | 0.04 | 0.08 | 2.19 | 0.46 | 0.14 | 2.79 | 0.79 | 0.35 | 0.71 |
| 10 | 0.75 | 0.71 | 0.42 | 0.29 | 0.28 | 0.84 | 0.37 | 0.71 | 0.74 | 0.24 | 0.09 | 0.03 | 0.04 | 0.25 | 0.09 | 0.05 | 0.43 | 0.60 | 0.31 | 0.38 |
| 11 | 0.36 | 0.18 | 0.42 | 0.24 | 0.23 | 0.74 | 0.41 | 0.32 | 0.56 | 0.08 | 0.11 | 0.04 | 0.03 | 0.20 | 0.09 | 0.02 | 0.30 | 0.09 | 0.53 | 0.50 |
| 12 | 0.14 | 0.15 | 0.49 | 0.29 | 0.16 | 0.35 | 0.13 | 0.16 | 0.22 | 0.04 | 0.03 | 0.01 | 0.02 | 0.01 | 0.02 | 0.00 | 0.06 | 0.02 | 0.12 | 0.94 |
| 13 | 0.06 | 0.06 | 0.21 | 0.17 | 0.17 | 0.16 | 0.11 | 0.12 | 0.11 | 0.01 | 0.04 | 0.00 | 0.01 | 0.07 | 0.00 | 0.00 | 0.03 | 0.02 | 0.00 | 0.12 |
| 14 | 0.05 | 0.03 | 0.12 | 0.10 | 0.16 | 0.15 | 0.05 | 0.09 | 0.07 | 0.01 | 0.01 | 0.01 | 0.01 | 0.03 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.06 |
| 15 | 0.04 | 0.00 | 0.03 | 0.06 | 0.06 | 0.09 | 0.09 | 0.01 | 0.04 | 0.02 | 0.01 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.03 |
| 16 | 0.04 | 0.04 | 0.03 | 0.04 | 0.04 | 0.10 | 0.06 | 0.05 | 0.03 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.03 |
| 17 | 0.01 | 0.00 | 0.05 | 0.02 | 0.05 | 0.01 | 0.04 | 0.01 | 0.02 | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 18 | 0.02 | 0.03 | 0.02 | 0.00 | 0.04 | 0.01 | 0.02 | 0.01 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 19 | 0.01 | 0.00 | 0.00 | 0.00 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 20 | 0.01 | 0.00 | 0.00 | 0.01 | 0.01 | 0.01 | 0.01 | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 21 | 0.01 | 0.01 | 0.02 | 0.00 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 22 | 0.00 | 0.00 | 0.01 | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 23 | 0.01 | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 24 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 25 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

Table 12. Mean length-at-age (cm) of cod sampled during research bottom-trawl surveys in Subdivision 3Ps in winter-spring 1972-2001. Entries in boxes are based on fewer than 5 aged fish. Some entries are different from those in Table 6 of Lilly (MS 1996) because only data from successful sets in the index strata are included in the present analyses.

| Age | 1972 | 1973 | 1974 | 1975 | 1976 | 1977 |
|---|---|---|---|---|---|---|
| 1 | 14.0 | 11.6 | 12.2 | 12.7 | 13.2 | 11.0 |
| 2 | 23.2 | 22.6 | 21.7 | 23.1 | 22.8 | 20.3 |
| 3 | 31.5 | 31.7 | 33.4 | 35.3 | 35.4 | 31.7 |
| 4 | 41.0 | 39.3 | 43.1 | 44.4 | 48.2 | 43.2 |
| 5 | 51.9 | 50.1 | 50.8 | 55.4 | 57.4 | 55.6 |
| 6 | 58.5 | 56.6 | 55.6 | 61.0 | 64.6 | 63.5 |
| 7 | 63.0 | 62.1 | 63.6 | 66.5 | 68.1 | 73.9 |
| 8 | 74.1 | 66.1 | 71.2 | 74.3 | 71.6 | 75.2 |
| 9 | 81.8 | 68.4 | 69.3 | 74.2 | 78.5 | 88.0 |
| 10 | 90.4 | 81.1 | 79.0 | 75.2 | 81.6 | 83.8 |
| 11 | 95.0 | 88.2 | 93.3 | 76.2 | 94.8 | 77.6 |
| 12 | 88.3 | 87.1 | 95.6 | 107.2 | 110.5 | 87.9 |

| Age | 1978 | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 |  | 10.8 | 14.6 | 14.6 | 13.2 | 10.3 | 12.0 |  | 11.0 | 10.7 | 9.2 | 12.0 |  | 9.5 |  |  |  |  |
| 2 | 19.6 | 22.1 | 21.0 | 22.4 | 22.0 | 20.2 | 19.2 | 17.9 | 18.7 | 19.9 | 19.7 | 19.2 | 20.0 | 19.2 | 20.7 |  | 19.1 | 21.2 |
| 3 | 28.0 | 32.2 | 28.1 | 32.4 | 33.3 | 31.2 | 30.6 | 29.0 | 26.8 | 29.5 | 29.0 | 30.1 | 29.9 | 29.5 | 30.5 | 30.9 | 32.3 | 30.1 |
| 4 | 35.9 | 42.6 | 42.9 | 44.4 | 44.9 | 43.0 | 42.1 | 40.3 | 40.3 | 39.4 | 40.8 | 41.6 | 40.0 | 38.5 | 40.9 | 41.1 | 39.2 | 41.4 |
| 5 | 48.0 | 47.4 | 50.6 | 50.6 | 53.4 | 52.6 | 51.8 | 50.9 | 48.6 | 48.1 | 47.5 | 47.9 | 48.0 | 46.9 | 47.1 | 48.0 | 48.0 | 50.3 |
| 6 | 59.0 | 56.3 | 58.2 | 58.6 | 59.3 | 57.8 | 60.6 | 60.0 | 55.5 | 53.9 | 56.2 | 56.0 | 53.7 | 53.3 | 55.1 | 52.6 | 50.2 | 56.4 |
| 7 | 65.6 | 70.5 | 71.3 | 63.2 | 66.4 | 65.4 | 66.2 | 66.3 | 62.1 | 61.1 | 61.9 | 63.9 | 56.6 | 57.4 | 61.1 | 62.2 | 53.6 | 58.2 |
| 8 | 70.1 | 76.8 | 84.8 | 69.9 | 70.1 | 71.4 | 70.6 | 74.0 | 72.1 | 67.3 | 66.7 | 71.8 | 62.2 | 62.7 | 62.4 | 70.3 | 59.1 | 57.9 |
| 9 | 84.1 | 85.8 | 94.9 | 72.6 | 75.6 | 73.3 | 75.6 | 74.3 | 76.4 | 77.8 | 74.6 | 75.9 | 70.1 | 68.1 | 66.6 | 77.1 | 68.0 | 63.0 |
| 10 | 86.3 | 95.3 | 98.0 | 83.2 | 90.6 | 79.4 | 78.9 | 79.3 | 82.6 | 85.4 | 79.7 | 84.4 | 76.1 | 73.7 | 73.4 | 80.5 | 88.0 | 79.8 |
| 11 | 88.3 | 94.3 | 97.2 | 97.6 | 98.7 | 89.6 | 84.1 | 89.1 | 93.3 | 83.1 | 79.7 | 88.5 | 79.4 | 73.8 | 83.6 | 96.0 | 79.3 | 81.2 |
| 12 | 79.3 | 116.0 | 106.6 | 90.1 | 104.6 | 94.1 | 98.2 | 93.0 | 93.8 | 89.9 | 87.5 | 96.5 | 88.7 | 77.2 | 81.8 | 106.0 | 90.3 | 83.6 |

| Age | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 |
|---|---|---|---|---|---|---|
| 1 | 12.6 | 12.7 | 10.6 | 12.0 | 13.3 | 10.6 |
| 2 | 20.6 | 24.1 | 22.3 | 22.2 | 22.0 | 21.9 |
| 3 | 30.0 | 31.7 | 32.5 | 31.4 | 31.7 | 33.3 |
| 4 | 38.6 | 40.8 | 42.5 | 42.9 | 40.7 | 40.7 |
| 5 | 44.0 | 47.9 | 48.7 | 51.2 | 48.6 | 47.3 |
| 6 | 52.9 | 51.5 | 53.2 | 58.9 | 54.6 | 51.8 |
| 7 | 60.9 | 60.6 | 57.5 | 61.7 | 60.3 | 57.3 |
| 8 | 61.1 | 65.2 | 67.0 | 66.2 | 65.3 | 68.4 |
| 9 | 63.3 | 66.9 | 77.2 | 77.6 | 67.8 | 78.2 |
| 10 | 76.7 | 67.3 | 77.2 | 86.5 | 81.1 | 75.8 |
| 11 | 74.7 | 82.5 | 64.3 | 76.9 | 92.5 | 89.0 |
| 12 | 86.1 |  | 78.0 | 109.0 | 89.1 | 96.2 |

Table 13. Mean round weight-at-age (kg) of cod sampled during DFO bottom-trawl surveys in Subdiv. 3Ps in winter-spring 1978-2001. Entries in boxes are based on fewer than 5 aged fish.

| Age | 1978 | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | 0.011 | 0.027 | | 0.040 | 0.010 | | | | | | | | 0.012 | | | | |
| 2 | 0.057 | 0.070 | 0.068 | 0.060 | 0.103 | 0.068 | 0.073 | | 0.045 | | 0.057 | 0.060 | 0.062 | 0.054 | 0.064 | | 0.053 | 0.062 |
| 3 | 0.177 | 0.258 | 0.147 | 0.265 | 0.420 | 0.232 | 0.268 | 0.214 | 0.168 | 0.248 | 0.193 | 0.239 | 0.208 | 0.217 | 0.230 | 0.220 | 0.254 | 0.212 |
| 4 | 0.396 | 0.633 | 0.618 | 0.704 | 0.829 | 0.718 | 0.632 | 0.505 | 0.462 | 0.538 | 0.582 | 0.613 | 0.538 | 0.465 | 0.574 | 0.550 | 0.460 | 0.540 |
| 5 | 0.979 | 0.879 | 1.005 | 1.079 | 1.299 | 1.301 | 1.212 | 1.039 | 0.905 | 0.950 | 0.915 | 0.901 | 0.954 | 0.865 | 0.865 | 0.894 | 0.898 | 1.017 |
| 6 | 1.735 | 1.565 | 1.634 | 1.673 | 1.539 | 1.652 | 1.853 | 1.566 | 1.332 | 1.273 | 1.494 | 1.331 | 1.348 | 1.324 | 1.461 | 1.150 | 1.044 | 1.514 |
| 7 | 2.368 | 3.029 | 3.457 | 2.081 | 2.555 | 1.861 | 2.790 | 2.279 | 2.384 | 1.885 | 2.214 | 2.361 | 1.621 | 1.702 | 2.032 | 1.987 | 1.236 | 1.687 |
| 8 | 3.192 | 5.666 | 5.791 | 3.496 | 2.612 | 3.555 | 3.828 | 3.206 | 3.337 | 2.297 | 2.423 | 3.778 | 2.185 | 2.346 | 2.258 | 3.003 | 1.814 | 1.585 |
| 9 | 4.676 | 5.798 | 8.459 | 4.890 | 4.007 | 4.042 | 4.225 | 3.143 | 5.023 | 4.483 | 3.943 | 4.505 | 3.060 | 3.087 | 2.859 | 4.281 | 2.891 | 2.209 |
| 10 | 5.711 | 7.108 | 8.333 | 7.591 | 6.441 | 4.896 | 5.029 | 3.760 | 4.654 | 6.344 | 4.839 | 5.820 | 4.225 | 3.956 | 3.983 | 4.470 | 6.450 | 4.767 |
| 11 | 4.901 | 9.030 | 9.085 | 8.374 | 8.885 | 8.848 | 7.866 | | 6.633 | 6.616 | 4.262 | 8.285 | 4.934 | 4.050 | 5.796 | 8.673 | 4.470 | 5.446 |
| 12 | 5.760 | | 10.158 | 11.463 | 13.068 | 10.270 | 9.818 | 3.970 | 8.867 | 5.945 | 9.103 | 9.061 | 7.365 | 4.906 | 5.240 | 13.200 | 6.748 | 5.544 |

| Age | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 |
|---|---|---|---|---|---|---|
| 1 | 0.018 | 0.016 | 0.011 | 0.014 | 0.018 | 0.012 |
| 2 | 0.072 | 0.108 | 0.091 | 0.095 | 0.087 | 0.086 |
| 3 | 0.218 | 0.257 | 0.282 | 0.286 | 0.272 | 0.293 |
| 4 | 0.461 | 0.552 | 0.659 | 0.646 | 0.562 | 0.545 |
| 5 | 0.673 | 0.878 | 0.941 | 1.130 | 0.953 | 0.819 |
| 6 | 1.283 | 1.076 | 1.274 | 1.709 | 1.333 | 1.204 |
| 7 | 2.009 | 1.904 | 1.640 | 1.992 | 1.902 | 1.668 |
| 8 | 2.084 | 2.608 | 2.791 | 2.549 | 2.376 | 2.999 |
| 9 | 2.136 | 2.867 | 4.660 | 4.565 | 2.904 | 4.453 |
| 10 | 4.464 | 3.083 | 4.441 | 6.567 | 5.437 | 4.402 |
| 11 | 3.897 | 5.456 | 2.528 | 4.265 | 8.351 | 6.949 |
| 12 | 6.793 | | 4.190 | 12.388 | 6.780 | 8.805 |

Table 14. Mean gutted condition-at-age of cod sampled during DFO bottom-trawl surveys in Subdivision 3Ps in winter-spring 1978-2001. Boxed entries are based on fewer than 5 aged fish.

| Age | 1978 | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | | | | | | | | | | | | | | | | | |
| 2 | 0.702 | 0.629 | 0.595 | 0.599 | 0.660 | 0.632 | 0.651 | | 0.699 | | 0.644 | 0.681 | 0.623 | 0.641 | 0.598 | | 0.627 | 0.630 |
| 3 | 0.745 | 0.678 | 0.620 | 0.718 | 0.731 | 0.742 | 0.734 | 0.706 | 0.698 | 0.736 | 0.713 | 0.725 | 0.680 | 0.706 | 0.711 | 0.657 | 0.675 | 0.687 |
| 4 | 0.733 | 0.715 | 0.680 | 0.748 | 0.740 | 0.777 | 0.735 | 0.704 | 0.704 | 0.725 | 0.739 | 0.739 | 0.726 | 0.710 | 0.732 | 0.711 | 0.677 | 0.690 |
| 5 | 0.753 | 0.702 | 0.703 | 0.724 | 0.722 | 0.766 | 0.703 | 0.680 | 0.733 | 0.735 | 0.731 | 0.734 | 0.744 | 0.720 | 0.716 | 0.700 | 0.705 | 0.702 |
| 6 | 0.730 | 0.712 | 0.709 | 0.745 | 0.676 | 0.794 | 0.711 | 0.714 | 0.709 | 0.717 | 0.731 | 0.741 | 0.743 | 0.746 | 0.733 | 0.663 | 0.680 | 0.708 |
| 7 | 0.744 | 0.699 | 0.724 | 0.729 | 0.699 | 0.737 | 0.728 | 0.739 | 0.721 | 0.735 | 0.736 | 0.748 | 0.735 | 0.741 | 0.735 | 0.677 | 0.660 | 0.703 |
| 8 | 0.716 | 0.775 | 0.734 | 0.763 | 0.690 | 0.725 | 0.726 | 0.714 | 0.717 | 0.720 | 0.736 | 0.780 | 0.726 | 0.738 | 0.727 | 0.698 | 0.676 | 0.665 |
| 9 | 0.737 | 0.749 | 0.765 | 0.748 | 0.731 | 0.744 | 0.730 | 0.733 | 0.676 | 0.768 | 0.777 | 0.793 | 0.735 | 0.753 | 0.738 | 0.758 | 0.687 | 0.701 |
| 10 | 0.793 | 0.803 | 0.715 | 0.810 | 0.751 | 0.793 | 0.741 | 0.740 | 0.719 | 0.770 | 0.789 | 0.834 | 0.764 | 0.777 | 0.732 | 0.684 | 0.732 | 0.725 |
| 11 | 0.681 | 0.648 | 0.784 | 0.790 | 0.758 | 0.819 | 0.808 | | 0.798 | 0.779 | 0.783 | 0.827 | 0.794 | 0.765 | 0.766 | 0.786 | 0.691 | 0.750 |
| 12 | 0.725 | | 0.759 | 0.843 | 0.833 | 0.865 | 0.834 | 0.681 | 0.789 | 0.774 | 0.813 | 0.852 | 0.793 | 0.794 | 0.744 | 0.852 | 0.717 | 0.753 |

| Age | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 |
|---|---|---|---|---|---|---|
| 1 | 0.754 | 0.727 | 0.898 | 0.673 | 0.594 | 0.963 |
| 2 | 0.697 | 0.674 | 0.660 | 0.675 | 0.666 | 0.665 |
| 3 | 0.706 | 0.717 | 0.699 | 0.704 | 0.696 | 0.684 |
| 4 | 0.709 | 0.725 | 0.720 | 0.697 | 0.707 | 0.686 |
| 5 | 0.695 | 0.702 | 0.704 | 0.694 | 0.688 | 0.680 |
| 6 | 0.713 | 0.683 | 0.680 | 0.688 | 0.677 | 0.722 |
| 7 | 0.715 | 0.693 | 0.689 | 0.690 | 0.674 | 0.659 |
| 8 | 0.722 | 0.714 | 0.725 | 0.686 | 0.674 | 0.699 |
| 9 | 0.671 | 0.713 | 0.757 | 0.722 | 0.698 | 0.702 |
| 10 | 0.758 | 0.751 | 0.742 | 0.762 | 0.754 | 0.695 |
| 11 | 0.725 | 0.785 | 0.748 | 0.722 | 0.784 | 0.732 |
| 12 | 0.760 | | 0.784 | 0.737 | 0.712 | 0.773 |

Table 15. Mean liver index at age of cod caught during bottom-trawl surveys in subdivision 3Ps.

| Age | 1978 | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 | 1991 | 1992 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | | | | | | | | | | | | | | |
| 2 | 0.0175 | 0.0142 | 0.0150 | 0.0118 | 0.0229 | 0.0247 | 0.0120 | 0.0236 | 0.0230 | 0.0304 | 0.0250 | 0.0279 | 0.0292 | 0.0250 | 0.0301 |
| 3 | 0.0223 | 0.0160 | 0.0114 | 0.0146 | 0.0244 | 0.0280 | 0.0167 | 0.0168 | 0.0233 | 0.0233 | 0.0227 | 0.0216 | 0.0213 | 0.0213 | 0.0200 |
| 4 | 0.0203 | 0.0181 | 0.0143 | 0.0188 | 0.0228 | 0.0323 | 0.0179 | 0.0175 | 0.0196 | 0.0225 | 0.0275 | 0.0266 | 0.0293 | 0.0280 | 0.0242 |
| 5 | 0.0227 | 0.0194 | 0.0189 | 0.0169 | 0.0230 | 0.0275 | 0.0142 | 0.0176 | 0.0214 | 0.0240 | 0.0281 | 0.0269 | 0.0335 | 0.0287 | 0.0315 |
| 6 | 0.0253 | 0.0218 | 0.0204 | 0.0194 | 0.0163 | 0.0348 | 0.0144 | 0.0217 | 0.0230 | 0.0241 | 0.0280 | 0.0300 | 0.0357 | 0.0309 | 0.0309 |
| 7 | 0.0256 | 0.0293 | 0.0262 | 0.0213 | 0.0207 | 0.0277 | 0.0195 | 0.0217 | 0.0237 | 0.0273 | 0.0279 | 0.0303 | 0.0376 | 0.0362 | 0.0263 |
| 8 | 0.0323 | 0.0359 | 0.0370 | 0.0322 | 0.0203 | 0.0303 | 0.0191 | 0.0233 | 0.0268 | 0.0291 | 0.0312 | 0.0341 | 0.0334 | 0.0337 | 0.0368 |
| 9 | 0.0284 | 0.0319 | 0.0381 | 0.0418 | 0.0225 | 0.0326 | 0.0188 | 0.0268 | 0.0303 | 0.0362 | 0.0357 | 0.0412 | 0.0349 | 0.0386 | 0.0400 |
| 10 | 0.0326 | 0.0362 | 0.0328 | 0.0470 | 0.0258 | 0.0327 | 0.0328 | 0.0301 | 0.0383 | 0.0462 | 0.0439 | 0.0432 | 0.0411 | 0.0410 | 0.0379 |
| 11 | 0.0256 | 0.0276 | 0.0381 | 0.0277 | 0.0356 | 0.0445 | 0.0330 | 0.0405 | 0.0435 | 0.0404 | 0.0495 | 0.0519 | 0.0471 | 0.0419 | 0.0473 |
| 12 | 0.0379 | | 0.0385 | 0.0415 | 0.0539 | 0.0462 | 0.0451 | 0.0435 | 0.0463 | 0.0482 | 0.0545 | 0.0689 | 0.0477 | 0.0373 | 0.0376 |

| Age | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 |
|---|---|---|---|---|---|---|---|---|---|
| 1 | | | | | | | | | |
| 2 | | 0.0304 | 0.0139 | 0.0252 | 0.0244 | 0.0247 | 0.0239 | 0.0241 | 0.0231 |
| 3 | 0.0106 | 0.0144 | 0.0111 | 0.0160 | 0.0208 | 0.0165 | 0.0205 | 0.0181 | 0.0150 |
| 4 | 0.0154 | 0.0138 | 0.0131 | 0.0161 | 0.0199 | 0.0206 | 0.0170 | 0.0152 | 0.0163 |
| 5 | 0.0180 | 0.0197 | 0.0209 | 0.0168 | 0.0201 | 0.0216 | 0.0167 | 0.0193 | 0.0158 |
| 6 | 0.0187 | 0.0221 | 0.0201 | 0.0201 | 0.0183 | 0.0249 | 0.0168 | 0.0191 | 0.0209 |
| 7 | 0.0184 | 0.0170 | 0.0211 | 0.0219 | 0.0230 | 0.0227 | 0.0210 | 0.0210 | 0.0181 |
| 8 | 0.0206 | 0.0211 | 0.0179 | 0.0231 | 0.0240 | 0.0346 | 0.0197 | 0.0222 | 0.0245 |
| 9 | 0.0280 | 0.0208 | 0.0189 | 0.0194 | 0.0273 | 0.0407 | 0.0294 | 0.0235 | 0.0270 |
| 10 | 0.0182 | 0.0423 | 0.0265 | 0.0303 | 0.0379 | 0.0424 | 0.0388 | 0.0342 | 0.0258 |
| 11 | 0.0346 | 0.0232 | 0.0343 | 0.0314 | 0.0396 | 0.0271 | 0.0234 | 0.0385 | 0.0294 |
| 12 | 0.0379 | 0.0326 | 0.0247 | 0.0202 | | 0.0284 | 0.0260 | 0.0298 | 0.0363 |

Table 16. Observed proportion mature at age (only ages 1-12 shown) by cohort (1954-2000) for female Atlantic cod (*Gadus morhua*) from NAFO Subdiv. 3Ps. Parameter estimates of the probit model are also shown: A50=median age at maturity (years); L95% and U95%=lower and upper 95% confidence intervals. SE=standard error, Int=intercept, N=number of fish aged, dot=no fish sampled, nf=no model fit.

| Age | 1954 | 1955 | 1956 | 1957 | 1958 | 1959 | 1960 | 1961 | 1962 | 1963 | 1964 | 1965 | 1966 | 1967 | 1968 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | . | . | . | . | . | 0.0000 | . | 0.0000 | 0.0000 | 0.0000 | 0.0000 | . | 0.0000 | . | . |
| 2 | . | . | . | . | 0.0000 | . | 0.0000 | 0.0000 | 0.0000 | 0.0000 | . | 0.0000 | 0.0000 | 0.0000 | . |
| 3 | . | . | . | 0.0000 | . | 0.0000 | 0.0000 | 0.0000 | 0.0000 | . | 0.0000 | 0.0000 | 0.0000 | . | . |
| 4 | . | . | 0.0000 | . | 0.0000 | 0.0175 | 0.0000 | 0.0152 | . | 0.0000 | 0.0000 | 0.0000 | . | . | 0.0000 |
| 5 | . | 0.0385 | . | 0.0588 | 0.0278 | 0.0625 | 0.1482 | . | 0.1429 | 0.0000 | 0.0513 | . | . | 0.0999 | 0.0793 |
| 6 | 0.1818 | . | 0.2667 | 0.1875 | 0.0526 | 0.4167 | . | 0.4615 | 0.5000 | 0.5574 | . | . | 0.4291 | 0.5760 | 0.4399 |
| 7 | . | 0.8125 | 0.4386 | 0.3333 | 0.7143 | . | 0.7692 | 1.0000 | 0.7917 | . | . | 0.6403 | 0.6788 | 1.0000 | 0.8683 |
| 8 | 1.0000 | 0.8000 | 0.6667 | 1.0000 | . | 1.0000 | 0.7500 | 0.9167 | . | . | 0.9239 | 0.9303 | 1.0000 | 1.0000 | 0.9482 |
| 9 | 0.8387 | 1.0000 | 1.0000 | . | 1.0000 | 1.0000 | 1.0000 | . | . | 1.0000 | 1.0000 | 1.0000 | 0.8306 | 0.7968 | 1.0000 |
| 10 | 1.0000 | 1.0000 | . | 1.0000 | 1.0000 | 1.0000 | . | . | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 11 | 1.0000 | . | 1.0000 | . | . | . | . | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 12 | . | 1.0000 | . | 1.0000 | . | . | 1.0000 | 1.0000 | . | 1.0000 | 1.0000 | 1.0000 | 1.0000 | . | 1.0000 |
| A50 | 7.36 | 6.82 | 7.18 | 7.07 | 6.88 | 6.17 | 6.37 | 6.15 | 6.13 | nf | 6.60 | 6.79 | 6.49 | 5.98 | 6.15 |
| L95% | 6.02 | 6.41 | 6.83 | 6.68 | 6.51 | 5.75 | 5.90 | 5.79 | 5.76 | nf | 6.20 | 6.38 | 6.16 | 5.53 | 5.90 |
| U95% | 8.09 | 7.16 | 7.70 | 7.96 | 7.68 | 7.07 | 7.03 | 6.66 | 6.59 | nf | 7.04 | 7.03 | 6.81 | 6.46 | 6.41 |
| Slope | 1.11 | 1.51 | 1.32 | 1.46 | 2.39 | 2.11 | 1.67 | 1.86 | 1.71 | nf | 1.93 | 2.42 | 1.55 | 1.69 | 2.14 |
| SE | 0.29 | 0.22 | 0.32 | 0.37 | 0.59 | 0.54 | 0.30 | 0.36 | 0.29 | nf | 0.24 | 0.60 | 0.24 | 0.38 | 0.29 |
| Int | -8.17 | -10.26 | -9.46 | -10.32 | -16.45 | -13.02 | -10.67 | -11.47 | -10.51 | nf | -12.72 | -16.42 | -10.06 | -10.08 | -13.16 |
| SE | 2.44 | 1.61 | 2.22 | 2.35 | 3.62 | 2.94 | 1.76 | 2.07 | 1.70 | nf | 1.57 | 4.24 | 1.60 | 2.25 | 1.79 |
| N | 58 | 143 | 134 | 133 | 230 | 161 | 176 | 245 | 233 | 235 | 316 | 292 | 383 | 139 | 215 |

| Age | 1969 | 1970 | 1971 | 1972 | 1973 | 1974 | 1975 | 1976 | 1977 | 1978 | 1979 | 1980 | 1981 | 1982 | 1983 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | . | . | 0.0000 | . | 0.0000 | 0.0000 | 0.0000 | . | . | . | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| 2 | . | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| 3 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| 4 | 0.0000 | 0.0000 | 0.0146 | 0.0145 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0950 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| 5 | 0.0781 | 0.1978 | 0.3348 | 0.2542 | 0.1095 | 0.0639 | 0.0993 | 0.0970 | 0.0278 | 0.1450 | 0.4093 | 0.0528 | 0.0264 | 0.0379 | 0.0161 |
| 6 | 0.5402 | 0.7052 | 0.4700 | 0.3296 | 0.3352 | 0.2117 | 0.4854 | 0.4401 | 0.5312 | 0.5867 | 0.3410 | 0.3495 | 0.2503 | 0.1662 | 0.4927 |
| 7 | 0.6892 | 0.9610 | 0.7704 | 0.6077 | 0.8661 | 0.7183 | 0.6866 | 0.9129 | 0.8488 | 0.8027 | 0.7137 | 0.6027 | 0.4023 | 0.7909 | 0.8001 |
| 8 | 0.8884 | 0.9298 | 0.9237 | 1.0000 | 0.9232 | 0.9340 | 1.0000 | 0.9121 | 1.0000 | 0.9565 | 0.8618 | 0.8531 | 0.9322 | 0.8208 | 0.8838 |
| 9 | 1.0000 | 0.8531 | 1.0000 | 1.0000 | 0.9624 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 0.8979 | 0.9653 | 1.0000 | 1.0000 | 1.0000 |
| 10 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 0.9380 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 11 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 12 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 0.9430 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| A50 | 6.16 | 5.80 | 5.98 | 6.31 | 6.44 | 6.56 | 6.26 | 6.35 | 6.13 | 5.99 | 6.26 | 6.60 | 6.88 | 6.62 | 6.28 |
| L95% | 5.86 | 5.51 | 5.73 | 6.07 | 6.19 | 6.38 | 6.02 | 5.97 | 5.91 | 5.81 | 5.92 | 6.42 | 6.69 | 6.44 | 6.04 |
| U95% | 6.51 | 6.13 | 6.23 | 6.57 | 6.73 | 6.75 | 6.49 | 6.80 | 6.35 | 6.17 | 6.57 | 6.79 | 7.09 | 6.81 | 6.55 |
| Slope | 1.68 | 1.53 | 1.31 | 1.41 | 1.45 | 2.00 | 1.78 | 1.36 | 2.51 | 1.79 | 1.03 | 1.43 | 1.74 | 2.01 | 1.89 |
| SE | 0.30 | 0.23 | 0.14 | 0.14 | 0.17 | 0.20 | 0.22 | 0.21 | 0.35 | 0.17 | 0.11 | 0.14 | 0.18 | 0.21 | 0.26 |
| Int | -10.37 | -8.86 | -7.84 | -8.91 | -9.36 | -13.15 | -11.16 | -8.60 | -15.36 | -10.73 | -6.45 | -9.41 | -11.99 | -13.31 | -11.89 |
| SE | 1.84 | 1.31 | 0.83 | 0.89 | 1.03 | 1.29 | 1.38 | 1.25 | 2.17 | 1.02 | 0.77 | 0.91 | 1.18 | 1.35 | 1.60 |
| N | 164 | 204 | 351 | 423 | 415 | 601 | 331 | 230 | 376 | 597 | 331 | 551 | 454 | 455 | 271 |

cont'd:

Table 16. Cont'd.

| Age | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | . | . | . | . | 0.0000 | . | 0.0000 | . | . | . | . | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| 2 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | . | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| 3 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| 4 | 0.0000 | 0.0000 | 0.0515 | 0.0000 | 0.0685 | 0.0000 | 0.0000 | 0.0000 | 0.0134 | 0.2347 | 0.1674 | 0.0446 | 0.1147 | 0.1392 | . |
| 5 | 0.0767 | 0.1096 | 0.1806 | 0.3493 | 0.4646 | 0.0192 | 0.1097 | 0.3859 | 0.7313 | 0.3624 | 0.4707 | 0.6334 | 0.2857 | . | . |
| 6 | 0.6213 | 0.4797 | 0.8676 | 0.9283 | 0.3469 | 0.4987 | 0.5164 | 0.8943 | 1.0000 | 0.7886 | 0.8056 | 0.4872 | . | . | . |
| 7 | 0.8402 | 0.9717 | 0.9352 | 0.9034 | 0.9604 | 0.7855 | 0.7440 | 1.0000 | 0.9694 | 0.9492 | 0.8758 | . | . | . | . |
| 8 | 1.0000 | 1.0000 | 1.0000 | 0.9430 | 0.9671 | 0.9207 | 1.0000 | 1.0000 | 0.9562 | 1.0000 | . | . | . | . | . |
| 9 | 1.0000 | 1.0000 | 1.0000 | 0.9622 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | . | . | . | . | . | . |
| 10 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | . | . | . | . | . | . | . |
| 11 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | . | . | . | . | . | . | . | . |
| 12 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | . | . | . | . | . | . | . | . |
| A50 | 6.01 | 5.94 | 5.45 | 5.29 | 5.06 | 5.19 | 5.15 | 5.17 | 5.26 | 5.26 | 5.17 | 5.70 | 5.42 | nf | nf |
| L95% | 5.78 | 5.76 | 5.28 | 5.12 | 4.84 | 5.07 | 4.96 | 4.94 | 4.82 | 4.95 | 4.89 | 5.30 | 4.96 | nf | nf |
| U95% | 6.25 | 6.13 | 5.62 | 5.45 | 5.24 | 5.32 | 5.35 | 5.56 | 5.41 | 5.54 | 5.47 | 6.26 | 7.06 | nf | nf |
| Slope | 2.23 | 2.70 | 2.58 | 2.25 | 2.77 | 1.88 | 1.79 | 3.55 | 2.33 | 1.81 | 1.55 | 1.40 | 1.87 | nf | nf |
| SE | 0.30 | 0.37 | 0.29 | 0.22 | 0.41 | 0.16 | 0.19 | 1.04 | 0.36 | 0.25 | 0.23 | 0.27 | 0.62 | nf | nf |
| Int | -13.42 | -16.03 | -14.07 | -11.92 | -14.02 | -9.78 | -9.20 | -18.35 | -11.88 | -9.53 | -8.02 | -7.98 | -10.15 | nf | nf |
| SE | 1.80 | 2.20 | 1.59 | 1.24 | 2.17 | 0.81 | 0.96 | 5.23 | 1.77 | 1.36 | 1.21 | 1.44 | 2.91 | nf | nf |
| N | 281 | 324 | 417 | 443 | 249 | 745 | 387 | 154 | 195 | 204 | 184 | 153 | 109 | 115 | 71 |

| Age | 1999 | 2000 |
|---|---|---|
| 1 | 0.0000 | 0.0000 |
| 2 | 0.0000 | . |
| 3 | . | . |
| 4 | . | . |
| 5 | . | . |
| 6 | . | . |
| 7 | . | . |
| 8 | . | . |
| 9 | . | . |
| 10 | . | . |
| 11 | . | . |
| 12 | . | . |
| A50 | nf | nf |
| L95% | nf | nf |
| U95% | nf | nf |
| Slope | nf | nf |
| SE | nf | nf |
| Int | nf | nf |
| SE | nf | nf |
| N | 45 | 4 |

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Table 17. Estimated proportions mature for female cod from NAFO Subdiv. 3Ps from DFO surveys from 1959 to 2001 projected forward to 2010. Estimates were obtained from a probit model fitted to observed proportions mature at age (see Table 16). Shaded cells are averages of the first or last three estimates for the same age group; boxed cells are the average of adjacent estimates for the same age group.

| Year/Age | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1959 | 0.0006 | 0.0040 | 0.0142 | 0.0676 | 0.1936 | 0.4697 | 0.7570 | 0.9133 | 0.9723 | 0.9914 | 0.9973 | 0.9992 | 0.9997 | 0.9999 | 1.0000 | 1.0000 |
| 1960 | 0.0000 | 0.0026 | 0.0149 | 0.0611 | 0.1801 | 0.4697 | 0.7570 | 0.9133 | 0.9723 | 0.9914 | 0.9973 | 0.9992 | 0.9997 | 0.9999 | 1.0000 | 1.0000 |
| 1961 | 0.0002 | 0.0001 | 0.0112 | 0.0535 | 0.2267 | 0.3996 | 0.7570 | 0.9133 | 0.9723 | 0.9914 | 0.9973 | 0.9992 | 0.9997 | 0.9999 | 1.0000 | 1.0000 |
| 1962 | 0.0007 | 0.0013 | 0.0010 | 0.0463 | 0.1741 | 0.5693 | 0.6686 | 0.9133 | 0.9723 | 0.9914 | 0.9973 | 0.9992 | 0.9997 | 0.9999 | 1.0000 | 1.0000 |
| 1963 | 0.0004 | 0.0035 | 0.0102 | 0.0111 | 0.1729 | 0.4403 | 0.8563 | 0.8595 | 0.9723 | 0.9914 | 0.9973 | 0.9992 | 0.9997 | 0.9999 | 1.0000 | 1.0000 |
| 1964 | 0.0008 | 0.0028 | 0.0185 | 0.0784 | 0.1097 | 0.4738 | 0.7459 | 0.9641 | 0.9488 | 0.9914 | 0.9973 | 0.9992 | 0.9997 | 0.9999 | 1.0000 | 1.0000 |
| 1965 | 0.0005 | 0.0046 | 0.0177 | 0.0913 | 0.4124 | 0.5742 | 0.7950 | 0.9164 | 0.9918 | 0.9825 | 0.9973 | 0.9992 | 0.9997 | 0.9999 | 1.0000 | 1.0000 |
| 1966 | 0.0001 | 0.0028 | 0.0252 | 0.1041 | 0.3489 | 0.8528 | 0.9366 | 0.9435 | 0.9761 | 0.9982 | 0.9942 | 0.9992 | 0.9997 | 0.9999 | 1.0000 | 1.0000 |
| 1967 | 0.0000 | 0.0010 | 0.0159 | 0.1254 | 0.4285 | 0.7408 | 0.9795 | 0.9939 | 0.9863 | 0.9935 | 0.9996 | 0.9981 | 0.9997 | 0.9999 | 1.0000 | 1.0000 |
| 1968 | 0.0010 | 0.0001 | 0.0066 | 0.0846 | 0.4433 | 0.8286 | 0.9384 | 0.9975 | 0.9994 | 0.9968 | 0.9983 | 0.9999 | 0.9994 | 0.9999 | 1.0000 | 1.0000 |
| 1969 | 0.0012 | 0.0044 | 0.0012 | 0.0438 | 0.3413 | 0.8155 | 0.9689 | 0.9879 | 0.9997 | 1.0000 | 0.9993 | 0.9995 | 1.0000 | 0.9998 | 1.0000 | 1.0000 |
| 1970 | 0.0001 | 0.0066 | 0.0205 | 0.0130 | 0.2394 | 0.7496 | 0.9608 | 0.9951 | 0.9977 | 1.0000 | 1.0000 | 0.9998 | 0.9999 | 1.0000 | 0.9999 | 1.0000 |
| 1971 | 0.0009 | 0.0012 | 0.0345 | 0.0898 | 0.1290 | 0.6837 | 0.9489 | 0.9927 | 0.9992 | 0.9996 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 1972 | 0.0030 | 0.0049 | 0.0099 | 0.1619 | 0.3171 | 0.6246 | 0.9369 | 0.9915 | 0.9987 | 0.9999 | 0.9999 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 1973 | 0.0054 | 0.0137 | 0.0257 | 0.0785 | 0.5110 | 0.6861 | 0.9492 | 0.9903 | 0.9986 | 0.9998 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 1974 | 0.0023 | 0.0197 | 0.0600 | 0.1243 | 0.4199 | 0.8497 | 0.9114 | 0.9953 | 0.9986 | 0.9998 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 1975 | 0.0016 | 0.0093 | 0.0696 | 0.2269 | 0.4332 | 0.8602 | 0.9683 | 0.9798 | 0.9996 | 0.9998 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 1976 | 0.0001 | 0.0067 | 0.0370 | 0.2174 | 0.5744 | 0.8044 | 0.9812 | 0.9940 | 0.9956 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 1977 | 0.0005 | 0.0008 | 0.0280 | 0.1361 | 0.5078 | 0.8613 | 0.9568 | 0.9978 | 0.9989 | 0.9991 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 1978 | 0.0028 | 0.0030 | 0.0058 | 0.1096 | 0.3927 | 0.7930 | 0.9662 | 0.9917 | 0.9997 | 0.9998 | 0.9998 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 1979 | 0.0000 | 0.0106 | 0.0176 | 0.0417 | 0.3446 | 0.7263 | 0.9343 | 0.9925 | 0.9984 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 1980 | 0.0008 | 0.0004 | 0.0400 | 0.0963 | 0.2442 | 0.6919 | 0.9159 | 0.9814 | 0.9984 | 0.9997 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 1981 | 0.0123 | 0.0047 | 0.0048 | 0.1390 | 0.3884 | 0.7056 | 0.9056 | 0.9781 | 0.9949 | 0.9996 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 1982 | 0.0014 | 0.0336 | 0.0276 | 0.0558 | 0.3849 | 0.7910 | 0.9468 | 0.9762 | 0.9946 | 0.9986 | 0.9999 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 1983 | 0.0002 | 0.0059 | 0.0888 | 0.1453 | 0.4202 | 0.7081 | 0.9576 | 0.9925 | 0.9943 | 0.9987 | 0.9996 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 1984 | 0.0001 | 0.0012 | 0.0240 | 0.2145 | 0.5050 | 0.8989 | 0.9039 | 0.9926 | 0.9990 | 0.9987 | 0.9997 | 0.9999 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 1985 | 0.0003 | 0.0007 | 0.0066 | 0.0930 | 0.4334 | 0.8596 | 0.9909 | 0.9733 | 0.9988 | 0.9999 | 0.9997 | 0.9999 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 1986 | 0.0001 | 0.0020 | 0.0051 | 0.0365 | 0.2992 | 0.6818 | 0.9735 | 0.9993 | 0.9930 | 0.9998 | 1.0000 | 0.9999 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 1987 | 0.0000 | 0.0012 | 0.0132 | 0.0369 | 0.1781 | 0.6402 | 0.8572 | 0.9955 | 0.9999 | 0.9982 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 1988 | 0.0001 | 0.0004 | 0.0111 | 0.0817 | 0.2224 | 0.5533 | 0.8811 | 0.9439 | 0.9992 | 1.0000 | 0.9995 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 1989 | 0.0006 | 0.0018 | 0.0053 | 0.0948 | 0.3715 | 0.6807 | 0.8762 | 0.9686 | 0.9792 | 0.9999 | 1.0000 | 0.9999 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 1990 | 0.0002 | 0.0057 | 0.0233 | 0.0732 | 0.4938 | 0.7971 | 0.9408 | 0.9759 | 0.9923 | 0.9925 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 1991 | 0.0024 | 0.0033 | 0.0516 | 0.2401 | 0.5399 | 0.9009 | 0.9631 | 0.9916 | 0.9957 | 0.9981 | 0.9973 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 1992 | 0.0036 | 0.0158 | 0.0507 | 0.3412 | 0.8071 | 0.9458 | 0.9883 | 0.9943 | 0.9989 | 0.9992 | 0.9996 | 0.9990 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 1993 | 0.0000 | 0.0210 | 0.0956 | 0.4611 | 0.8313 | 0.9823 | 0.9962 | 0.9987 | 0.9991 | 0.9999 | 0.9999 | 0.9999 | 0.9997 | 1.0000 | 1.0000 | 1.0000 |
| 1994 | 0.0007 | 0.0005 | 0.1137 | 0.4102 | 0.9320 | 0.9791 | 0.9986 | 0.9997 | 0.9999 | 0.9999 | 1.0000 | 1.0000 | 1.0000 | 0.9999 | 1.0000 | 1.0000 |
| 1995 | 0.0027 | 0.0076 | 0.0155 | 0.4336 | 0.8207 | 0.9955 | 0.9978 | 0.9999 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 1996 | 0.0073 | 0.0164 | 0.0729 | 0.3530 | 0.8205 | 0.9679 | 0.9997 | 0.9998 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 1997 | 0.0056 | 0.0333 | 0.0928 | 0.4477 | 0.9499 | 0.9647 | 0.9950 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 1998 | 0.0017 | 0.0224 | 0.1399 | 0.3853 | 0.8931 | 0.9965 | 0.9939 | 0.9992 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 1999 | 0.0048 | 0.0106 | 0.0850 | 0.4341 | 0.7935 | 0.9885 | 1.0000 | 0.9990 | 0.9999 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 2000 | 0.0048 | 0.0221 | 0.0651 | 0.2741 | 0.7835 | 0.9593 | 0.9989 | 1.0000 | 0.9998 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 2001 | 0.0048 | 0.0221 | 0.0967 | 0.3113 | 0.6054 | 0.9446 | 0.9931 | 0.9999 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 2002 | 0.0048 | 0.0221 | 0.0967 | 0.3398 | 0.7459 | 0.8618 | 0.9877 | 0.9969 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 2003 | 0.0048 | 0.0221 | 0.0967 | 0.3398 | 0.7116 | 0.9502 | 0.9620 | 0.9974 | 0.9998 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 2004 | 0.0048 | 0.0221 | 0.0967 | 0.3398 | 0.7116 | 0.9189 | 0.9920 | 0.9904 | 0.9994 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 2005 | 0.0048 | 0.0221 | 0.0967 | 0.3398 | 0.7116 | 0.9189 | 0.9806 | 0.9988 | 0.9976 | 0.9999 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 2006 | 0.0048 | 0.0221 | 0.0967 | 0.3398 | 0.7116 | 0.9189 | 0.9806 | 0.9955 | 0.9998 | 0.9994 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 2007 | 0.0048 | 0.0221 | 0.0967 | 0.3398 | 0.7116 | 0.9189 | 0.9806 | 0.9955 | 0.9990 | 1.0000 | 0.9999 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 2008 | 0.0048 | 0.0221 | 0.0967 | 0.3398 | 0.7116 | 0.9189 | 0.9806 | 0.9955 | 0.9990 | 0.9998 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 2009 | 0.0048 | 0.0221 | 0.0967 | 0.3398 | 0.7116 | 0.9189 | 0.9806 | 0.9955 | 0.9990 | 0.9998 | 0.9999 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 2010 | 0.0048 | 0.0221 | 0.0967 | 0.3398 | 0.7116 | 0.9189 | 0.9806 | 0.9955 | 0.9990 | 0.9998 | 0.9999 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |

Table 17. Estimated proportions mature for female cod from NAFO Subdiv. 3Ps from DFO surveys from 1959 to 2001 projected forward to 2010. Estimates were obtained from a probit model fitted to observed proportions mature at age (see Table 16). Shaded cells are averages of the first or last three estimates for the same age group; boxed cells are the average of adjacent estimates for the same age group.

| Year/Age | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1959** | 0.0006 | 0.0040 | 0.0142 | 0.0676 | 0.1936 | 0.4697 | 0.7570 | 0.9133 | 0.9723 | 0.9914 | 0.9973 | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| **1960** | 0.0000 | 0.0026 | 0.0149 | 0.0611 | 0.1801 | 0.4697 | 0.7570 | 0.9133 | 0.9723 | 0.9914 | 0.9973 | 0.9992 | 0.9997 | 0.9999 | 1.0000 | 1.0000 |
| **1961** | 0.0002 | 0.0001 | 0.0112 | 0.0535 | 0.2267 | 0.3996 | 0.7570 | 0.9133 | 0.9723 | 0.9914 | 0.9973 | 0.9992 | 0.9997 | 0.9999 | 1.0000 | 1.0000 |
| **1962** | 0.0007 | 0.0013 | 0.0010 | 0.0463 | 0.1741 | 0.5693 | 0.6686 | 0.9133 | 0.9723 | 0.9914 | 0.9973 | 0.9992 | 0.9997 | 0.9999 | 1.0000 | 1.0000 |
| **1963** | 0.0004 | 0.0035 | 0.0102 | 0.0111 | 0.1729 | 0.4403 | 0.8563 | 0.8595 | 0.9723 | 0.9914 | 0.9973 | 0.9992 | 0.9997 | 0.9999 | 1.0000 | 1.0000 |
| **1964** | 0.0008 | 0.0028 | 0.0185 | 0.0784 | 0.1097 | 0.4738 | 0.7459 | 0.9641 | 0.9488 | 0.9914 | 0.9973 | 0.9992 | 0.9997 | 0.9999 | 1.0000 | 1.0000 |
| **1965** | 0.0005 | 0.0046 | 0.0177 | 0.0913 | 0.4124 | 0.5742 | 0.7950 | 0.9164 | 0.9918 | 0.9825 | 0.9973 | 0.9992 | 0.9997 | 0.9999 | 1.0000 | 1.0000 |
| **1966** | 0.0001 | 0.0028 | 0.0252 | 0.1041 | 0.3489 | 0.8528 | 0.9366 | 0.9435 | 0.9761 | 0.9982 | 0.9942 | [illegible] | 0.9997 | 0.9999 | 1.0000 | 1.0000 |
| **1967** | 0.0000 | 0.0010 | 0.0159 | 0.1254 | 0.4285 | 0.7408 | 0.9795 | 0.9939 | 0.9863 | 0.9935 | 0.9996 | 0.9981 | [illegible] | 0.9999 | 1.0000 | 1.0000 |
| **1968** | 0.0010 | 0.0001 | 0.0066 | 0.0846 | 0.4433 | 0.8286 | 0.9384 | 0.9975 | 0.9994 | 0.9968 | 0.9983 | 0.9999 | 0.9994 | [illegible] | 1.0000 | 1.0000 |
| **1969** | 0.0012 | 0.0044 | 0.0012 | 0.0438 | 0.3413 | 0.8155 | 0.9689 | 0.9879 | 0.9997 | 1.0000 | 0.9993 | 0.9995 | 1.0000 | 0.9998 | [illegible] | [illegible] |
| **1970** | 0.0001 | 0.0066 | 0.0205 | 0.0130 | 0.2394 | 0.7496 | 0.9608 | 0.9951 | 0.9977 | 1.0000 | 1.0000 | 0.9998 | 0.9999 | 1.0000 | 0.9999 | [illegible] |
| **1971** | 0.0009 | 0.0012 | 0.0345 | 0.0898 | 0.1290 | 0.6837 | 0.9489 | 0.9927 | 0.9992 | 0.9996 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| **1972** | 0.0030 | 0.0049 | 0.0099 | 0.1619 | 0.3171 | 0.6246 | 0.9369 | 0.9915 | 0.9987 | 0.9999 | 0.9999 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| **1973** | 0.0054 | 0.0137 | 0.0257 | 0.0785 | 0.5110 | 0.6861 | 0.9492 | 0.9903 | 0.9986 | 0.9998 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| **1974** | 0.0023 | 0.0197 | 0.0600 | 0.1243 | 0.4199 | 0.8497 | 0.9114 | 0.9953 | 0.9986 | 0.9998 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| **1975** | 0.0016 | 0.0093 | 0.0696 | 0.2269 | 0.4332 | 0.8602 | 0.9683 | 0.9798 | 0.9996 | 0.9998 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| **1976** | 0.0001 | 0.0067 | 0.0370 | 0.2174 | 0.5744 | 0.8044 | 0.9812 | 0.9940 | 0.9956 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| **1977** | 0.0005 | 0.0008 | 0.0280 | 0.1361 | 0.5078 | 0.8613 | 0.9568 | 0.9978 | 0.9989 | 0.9991 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| **1978** | 0.0028 | 0.0030 | 0.0058 | 0.1096 | 0.3927 | 0.7930 | 0.9662 | 0.9917 | 0.9997 | 0.9998 | 0.9998 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| **1979** | 0.0000 | 0.0106 | 0.0176 | 0.0417 | 0.3446 | 0.7263 | 0.9343 | 0.9925 | 0.9984 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| **1980** | 0.0008 | 0.0004 | 0.0400 | 0.0963 | 0.2442 | 0.6919 | 0.9159 | 0.9814 | 0.9984 | 0.9997 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| **1981** | 0.0123 | 0.0047 | 0.0048 | 0.1390 | 0.3884 | 0.7056 | 0.9056 | 0.9781 | 0.9949 | 0.9996 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| **1982** | 0.0014 | 0.0336 | 0.0276 | 0.0558 | 0.3849 | 0.7910 | 0.9468 | 0.9762 | 0.9946 | 0.9986 | 0.9999 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| **1983** | 0.0002 | 0.0059 | 0.0888 | 0.1453 | 0.4202 | 0.7081 | 0.9576 | 0.9925 | 0.9943 | 0.9987 | 0.9996 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| **1984** | 0.0001 | 0.0012 | 0.0240 | 0.2145 | 0.5050 | 0.8989 | 0.9039 | 0.9926 | 0.9990 | 0.9987 | 0.9997 | 0.9999 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| **1985** | 0.0003 | 0.0007 | 0.0066 | 0.0930 | 0.4334 | 0.8596 | 0.9909 | 0.9733 | 0.9988 | 0.9999 | 0.9997 | 0.9999 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| **1986** | 0.0001 | 0.0020 | 0.0051 | 0.0365 | 0.2992 | 0.6818 | 0.9735 | 0.9993 | 0.9930 | 0.9998 | 1.0000 | 0.9999 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| **1987** | 0.0000 | 0.0012 | 0.0132 | 0.0369 | 0.1781 | 0.6402 | 0.8572 | 0.9955 | 0.9999 | 0.9982 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| **1988** | 0.0001 | 0.0004 | 0.0111 | 0.0817 | 0.2224 | 0.5533 | 0.8811 | 0.9439 | 0.9992 | 1.0000 | 0.9995 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| **1989** | 0.0006 | 0.0018 | 0.0053 | 0.0948 | 0.3715 | 0.6807 | 0.8762 | 0.9686 | 0.9792 | 0.9999 | 1.0000 | 0.9999 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| **1990** | 0.0002 | 0.0057 | 0.0233 | 0.0732 | 0.4938 | 0.7971 | 0.9408 | 0.9759 | 0.9923 | 0.9925 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| **1991** | 0.0024 | 0.0033 | 0.0516 | 0.2401 | 0.5399 | 0.9009 | 0.9631 | 0.9916 | 0.9957 | 0.9981 | 0.9973 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| **1992** | 0.0036 | 0.0158 | 0.0507 | 0.3412 | 0.8071 | 0.9458 | 0.9883 | 0.9943 | 0.9989 | 0.9992 | 0.9996 | 0.9990 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| **1993** | 0.0000 | 0.0210 | 0.0956 | 0.4611 | 0.8313 | 0.9823 | 0.9962 | 0.9987 | 0.9991 | 0.9999 | 0.9999 | 0.9999 | 0.9997 | 1.0000 | 1.0000 | 1.0000 |
| **1994** | 0.0007 | 0.0005 | 0.1137 | 0.4102 | 0.9320 | 0.9791 | 0.9986 | 0.9997 | 0.9999 | 0.9999 | 1.0000 | 1.0000 | 1.0000 | 0.9999 | 1.0000 | 1.0000 |
| **1995** | 0.0027 | 0.0076 | 0.0155 | 0.4336 | 0.8207 | 0.9955 | 0.9978 | 0.9999 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| **1996** | 0.0073 | 0.0164 | 0.0729 | 0.3530 | 0.8205 | 0.9679 | 0.9997 | 0.9998 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| **1997** | 0.0056 | 0.0333 | 0.0928 | 0.4477 | 0.9499 | 0.9647 | 0.9950 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| **1998** | 0.0017 | 0.0224 | 0.1399 | 0.3853 | 0.8931 | 0.9985 | 0.9939 | 0.9992 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| **1999** | [illegible] | 0.0106 | 0.0850 | 0.4341 | 0.7935 | 0.9885 | 1.0000 | 0.9990 | 0.9999 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| **2000** | 0.0048 | [illegible] | 0.0651 | 0.2741 | 0.7835 | 0.9593 | 0.9989 | 1.0000 | 0.9998 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| **2001** | 0.0048 | 0.0221 | [illegible] | 0.3113 | 0.6054 | 0.9446 | 0.9931 | 0.9999 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| **2002** | 0.0048 | 0.0221 | 0.0967 | [illegible] | 0.7459 | 0.8618 | 0.9877 | 0.9989 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| **2003** | 0.0048 | 0.0221 | 0.0967 | 0.3398 | [illegible] | 0.9502 | 0.9620 | 0.9974 | 0.9998 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| **2004** | 0.0048 | 0.0221 | 0.0967 | 0.3398 | 0.7116 | [illegible] | 0.9920 | 0.9904 | 0.9994 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| **2005** | 0.0048 | 0.0221 | 0.0967 | 0.3398 | 0.7116 | 0.9189 | [illegible] | 0.9988 | 0.9976 | 0.9999 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| **2006** | 0.0048 | 0.0221 | 0.0967 | 0.3398 | 0.7116 | 0.9189 | 0.9806 | 0.9955 | 0.9998 | 0.9994 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| **2007** | 0.0048 | 0.0221 | 0.0967 | 0.3398 | 0.7116 | 0.9189 | 0.9806 | 0.9955 | [illegible] | 1.0000 | 0.9999 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| **2008** | 0.0048 | 0.0221 | 0.0967 | 0.3398 | 0.7116 | 0.9189 | 0.9806 | 0.9955 | 0.9989 | [illegible] | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| **2009** | 0.0048 | 0.0221 | 0.0967 | 0.3398 | 0.7116 | 0.9189 | 0.9806 | 0.9955 | 0.9989 | 0.9998 | [illegible] | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| **2010** | 0.0048 | 0.0221 | 0.0967 | [illegible] | 0.7116 | 0.9189 | 0.9806 | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | 1.0000 | 1.0000 | 1.0000 | 1.0000 |

Table 18. The amount of variation in the data explained by each effect alone.

| Data | Effect | DF | SS | MS | F | P | $R^2$ | Root MSE |
|---|---|---|---|---|---|---|---|---|
| Commercial catch | Age | 12 | 1642.5 | 136.9 | 73.96 | <0.0001 | 0.64 | 1.360 |
| | Year class | 53 | 273.5 | 5.2 | 1.02 | 0.4354 | 0.11 | 2.247 |
| | Year | 42 | 494.1 | 11.8 | 2.64 | <0.0001 | 0.19 | 2.110 |
| RV survey (no split) | Age | 13 | 635.0 | 48.8 | 49.28 | <0.0001 | 0.72 | 0.996 |
| | Year class | 31 | 158.7 | 5.1 | 1.64 | 0.0229 | 0.18 | 1.769 |
| | Year | 18 | 104.1 | 5.8 | 1.81 | 0.0243 | 0.12 | 1.785 |
| RV survey (eastern) | Age | 13 | 534.3 | 41.1 | 28.67 | <0.0001 | 0.61 | 1.197 |
| | Year class | 31 | 152.8 | 4.9 | 1.52 | 0.0465 | 0.17 | 1.803 |
| | Year | 18 | 136.1 | 7.6 | 2.40 | 0.0015 | 0.15 | 1.773 |
| RV survey (western) | Age | 13 | 349.2 | 26.9 | 37.31 | <0.0001 | 0.84 | 0.848 |
| | Year class | 21 | 235.9 | 11.2 | 5.13 | <0.0001 | 0.57 | 1.480 |
| | Year | 8 | 52.2 | 6.5 | 1.70 | 0.1083 | 0.13 | 1.960 |
| Sentinel gillnet | Age | 7 | 168.0 | 24.0 | 23.21 | <0.0001 | 0.81 | 1.017 |
| | Year class | 12 | 101.2 | 8.4 | 2.68 | 0.0120 | 0.49 | 1.775 |
| | Year | 5 | 18.7 | 3.7 | 0.81 | 0.5488 | 0.09 | 2.150 |
| Sentinel linetrawl | Age | 7 | 46.6 | 6.7 | 27.70 | <0.0001 | 0.83 | 0.490 |
| | Year class | 12 | 17.7 | 1.5 | 1.34 | 0.2406 | 0.31 | 1.049 |
| | Year | 5 | 1.6 | 0.3 | 0.25 | 0.9360 | 0.03 | 1.140 |
| Cameron survey | Age | 13 | 388.9 | 29.9 | 32.24 | <0.0001 | 0.77 | 0.963 |
| | Year class | 23 | 242.3 | 10.5 | 4.66 | <0.0001 | 0.48 | 1.503 |
| | Year | 10 | 22.3 | 2.2 | 0.60 | 0.8136 | 0.04 | 1.931 |
| GEAC survey | Age | 13 | 97.6 | 7.5 | 4.89 | <0.0001 | 0.64 | 1.239 |
| | Year class | 13 | 94.5 | 7.3 | 4.47 | 0.0002 | 0.62 | 1.275 |
| | Year | 3 | 24.9 | 8.3 | 2.95 | 0.0425 | 0.16 | 1.677 |
| Acoustic survey | Age | 10 | 151.4 | 15.1 | 14.80 | <0.0001 | 0.73 | 1.011 |
| | Year class | 14 | 77.4 | 5.5 | 2.14 | 0.0252 | 0.37 | 1.608 |
| | Year | 5 | 4.2 | 0.8 | 0.25 | 0.9394 | 0.02 | 1.852 |

Table 19. The sequential improvement in the sums of squares when the effects are added in the order of age, year class and year (Type I error)

| Data | Effect | DF | SS | MS | F | P | $R^2$ | Root MSE |
|---|---|---|---|---|---|---|---|---|
| Commercial catch | Age | 12 | 1642.5 | 136.9 | 610.24 | <0.0001 | 0.96 | 0.474 |
| | Year class | 52 | 434.2 | 8.4 | 37.23 | <0.0001 | | |
| | Year | 41 | 388.4 | 9.5 | 42.23 | <0.0001 | | |
| RV survey (no split) | Age | 13 | 635.0 | 48.8 | 134.55 | <0.0001 | 0.92 | 0.603 |
| | Year class | 31 | 64.0 | 2.1 | 5.68 | <0.0001 | | |
| | Year | 17 | 109.9 | 6.5 | 17.81 | <0.0001 | | |
| RV survey (eastern) | Age | 13 | 534.3 | 41.1 | 83.25 | <0.0001 | 0.89 | 0.703 |
| | Year class | 31 | 100.7 | 3.2 | 6.58 | <0.0001 | | |
| | Year | 17 | 150.4 | 8.8 | 17.92 | <0.0001 | | |
| RV survey (western) | Age | 13 | 349.2 | 26.9 | 81.15 | <0.0001 | 0.95 | 0.575 |
| | Year class | 21 | 22.1 | 1.1 | 3.17 | 0.0002 | | |
| | Year | 7 | 21.8 | 3.1 | 9.42 | <0.0001 | | |
| Sentinel gillnet | Age | 7 | 168.0 | 24.0 | 191.78 | <0.0001 | 0.99 | 0.354 |
| | Year class | 12 | 33.1 | 2.8 | 22.02 | <0.0001 | | |
| | Year | 4 | 4.4 | 1.1 | 8.74 | 0.0002 | | |
| Sentinel linetrawl | Age | 7 | 46.6 | 6.7 | 71.31 | <0.0001 | 0.96 | 0.305 |
| | Year class | 12 | 6.5 | 0.5 | 5.82 | 0.0001 | | |
| | Year | 4 | 0.9 | 0.2 | 2.29 | 0.0894 | | |
| Cameron survey | Age | 13 | 388.9 | 29.9 | 58.25 | <0.0001 | 0.90 | 0.717 |
| | Year class | 23 | 42.9 | 1.9 | 3.63 | <0.0001 | | |
| | Year | 9 | 26.2 | 2.9 | 5.66 | <0.0001 | | |
| GEAC survey | Age | 13 | 97.6 | 7.5 | 15.58 | <0.0001 | 0.94 | 0.694 |
| | Year class | 13 | 30.3 | 2.3 | 4.83 | 0.0009 | | |
| | Year | 2 | 13.8 | 6.9 | 14.34 | 0.0001 | | |
| Acoustic survey | Age | 10 | 151.4 | 15.1 | 18.55 | <0.0001 | 0.86 | 0.904 |
| | Year class | 14 | 20.0 | 1.4 | 1.75 | 0.0885 | | |
| | Year | 4 | 5.9 | 1.5 | 1.80 | 0.1505 | | |

Table 20. The improvement in the error sums of squares when the effect is added to the model after all other effects have been taken into account (Type III SS).

| Data | Effect | DF | SS | MS | F | P | $R^2$ | Root MSE |
|---|---|---|---|---|---|---|---|---|
| Commercial catch | Age | 10 | 409.7 | 41.0 | 182.65 | <0.0001 | 0.96 | 0.474 |
| | Year class | 51 | 163.5 | 3.2 | 14.29 | <0.0001 | | |
| | Year | 41 | 388.4 | 9.4 | 42.23 | <0.0001 | | |
| | Error | 400 | 89.7 | 0.2 | | | | |
| RV survey (no split) | Age | 12 | 140.0 | 11.7 | 32.13 | <0.0001 | 0.91 | 0.603 |
| | Year class | 30 | 51.9 | 1.7 | 4.76 | <0.0001 | | |
| | Year | 17 | 109.9 | 6.5 | 17.81 | <0.0001 | | |
| | Error | 201 | 73.0 | 0.4 | | | | |
| RV survey (eastern) | Age | 12 | 88.6 | 7.4 | 14.95 | <0.0001 | 0.89 | 0.703 |
| | Year class | 30 | 78.9 | 2.6 | 5.32 | <0.0001 | | |
| | Year | 17 | 150.4 | 8.8 | 17.92 | <0.0001 | | |
| | Error | 194 | 95.8 | 0.5 | | | | |
| RV survey (western) | Age | 12 | 78.2 | 6.5 | 19.70 | <0.0001 | 0.95 | 0.575 |
| | Year class | 20 | 16.3 | 0.8 | 2.46 | 0.0040 | | |
| | Year | 7 | 21.8 | 3.1 | 9.42 | <0.0001 | | |
| | Error | 61 | 20.2 | 0.3 | | | | |
| Sentinel gillnet | Age | 6 | 102.7 | 17.1 | 136.70 | <0.0001 | 0.99 | 0.354 |
| | Year class | 11 | 13.7 | 1.4 | 9.90 | <0.0001 | | |
| | Year | 4 | 4.4 | 1.1 | 8.70 | 0.0002 | | |
| | Error | 23 | 2.9 | 0.1 | | | | |
| Sentinel linetrawl | Age | 6 | 20.1 | 3.3 | 45.84 | <0.0001 | 0.96 | 0.306 |
| | Year class | 11 | 5.7 | 0.5 | 5.58 | 0.0002 | | |
| | Year | 4 | 0.9 | 0.2 | 2.29 | 0.0900 | | |
| | Error | 24 | 2.2 | 0.1 | | | | |
| Cameron survey | Age | 12 | 120.9 | 10.1 | 19.60 | <0.0001 | 0.90 | 0.717 |
| | Year class | 22 | 40.5 | 1.8 | 3.60 | <0.0001 | | |
| | Year | 9 | 26.2 | 2.9 | 5.70 | <0.0001 | | |
| | Error | 95 | 48.8 | 0.5 | | | | |
| GEAC survey | Age | 12 | 25.9 | 2.2 | 4.47 | 0.0016 | 0.94 | 0.694 |
| | Year class | 12 | 24.9 | 2.1 | 4.30 | 0.0020 | | |
| | Year | 2 | 13.8 | 6.9 | 14.34 | 0.0010 | | |
| | Error | 20 | 9.6 | 0.5 | | | | |
| Acoustic survey | Age | 9 | 83.6 | 9.3 | 11.37 | <0.0001 | 0.86 | 0.904 |
| | Year class | 13 | 21.0 | 1.6 | 1.97 | 0.0537 | | |
| | Year | 4 | 5.9 | 1.5 | 1.80 | 0.1505 | | |
| | Error | 36 | 29.4 | 0.82 | | | | |

Table 21. Output from the comparison run of the QLSPA for 3Ps cod (this run used the same formulation as the final model in the 2000 stock assessment with an additional year of data).

```
                              Optimization Start
                              Parameter Estimates
                                      Gradient           Lower          Upper
                                     Objective           Bound          Bound
  N Parameter         Estimate        Function      Constraint     Constraint

  1 x1                       0        1.527527      -13.815511              .
  2 x2                       0        1.636292      -13.815511              .
  3 x3                       0        0.455200      -13.815511              .
  4 x4                       0        0.215973      -13.815511              .
  5 x5                       0        7.792557      -13.815511              .
  6 x6                       0        2.311935      -13.815511              .
  7 x7                       0        2.685974      -13.815511              .
  8 x8                       0        8.321075      -13.815511              .
  9 x9                       0       25.056396      -13.815511              .
 10 x10              11.719940        1.276938      -11.512925              .
 11 x11              11.461632        1.245276       -1.209398              .
 12 x12              10.645425       -5.366476        3.176368              .
 13 x13               9.852194        9.296926        3.808576              .
 14 x14               9.305651        2.025930        4.087063              .
 15 x15               8.853665        4.212340        5.056117              .
 16 x16               8.389360        9.383862        4.999006              .
 17 x17               8.070906        3.770753        4.665373              .
 18 x18               7.740664        7.849549        4.147527              .
 19 x19               8.517193        1.198482        4.294558              .
 20 x20               9.047821       25.061093        4.451582              .
 21 x21               8.006368       21.951525        2.961460              .
 22 x22               1.098612       46.978196     0.000010000      13.815511
 23 x23               1.098612       19.671973     0.000010000      13.815511
 24 x24               1.098612       45.149217     0.000010000      13.815511
 25 x25               1.098612        1.716927     0.000010000      13.815511
 26 x26               1.098612       17.699056     0.000010000      13.815511

Value of Objective Function = 1198.8055199
```

Table 21. Cont'd.

```
Dual Quasi-Newton Optimization

Minimum Iterations                                      0
Maximum Iterations                                    500
Maximum Function Calls                               2500
ABSGCONV Gradient Criterion                       0.00001
GCONV Gradient Criterion                             1E-8
ABSFCONV Function Criterion                             0
FCONV Function Criterion                     2.220446E-16
FCONV2 Function Criterion                               0
FSIZE Parameter                                         0
ABSXCONV Parameter Change Criterion                     0
XCONV Parameter Change Criterion                        0
XSIZE Parameter                                         0
ABSCONV Function Criterion                   -1.34078E154
Line Search Method                                      2
Starting Alpha for Line Search                          1
Line Search Precision LSPRECISION                     0.4
DAMPSTEP Parameter for Line Search                      .
MAXSTEP Parameter for Line Search                       0
FD Derivatives: Accurate Digits in Obj.F      15.653559775
Singularity Tolerance (SINGULAR)                     1E-8
Constraint Precision (LCEPS)                         1E-8
Linearly Dependent Constraints (LCSING)              1E-8
Releasing Active Constraints (LCDEACT)                  .
Dual Quasi-Newton Optimization

Dual Broyden - Fletcher - Goldfarb - Shanno Update (DBFGS)
Gradient Computed by Finite Differences

Parameter Estimates              26
Lower Bounds                     26
Upper Bounds                      5


Iterations                                       33  Function Calls
82
Gradient Calls                                   60  Active Constraints
0
Objective Function                      935.20632654  Max Abs Gradient Element
0.018521597
Slope of Search Direction               -1.946085E-6

GCONV convergence criterion satisfied.

NOTE: At least one element of the (projected) gradient is greater than 1e-3.
```

Table 21. Cont'd.

```
                  Optimization Results
                  Parameter Estimates
                                               Gradient
                                              Objective
 N Parameter            Estimate               Function

 1 x1                  -1.120528              -0.001105
 2 x2                  -1.277051               0.000965
 3 x3                  -1.613065              -0.000660
 4 x4                  -1.068771              -0.000723
 5 x5                  -0.838491              -0.000905
 6 x6                  -2.224614              -0.000596
 7 x7                  -0.574951              -0.001352
 8 x8                  -0.981467               0.000566
 9 x9                  -1.631815               0.001821
10 x10                 11.316347               0.001533
11 x11                 11.015659           -0.000049526
12 x12                 10.480565              -0.001536
13 x13                  9.251077              -0.000272
14 x14                  8.868884              -0.000254
15 x15                  8.359774              -0.000152
16 x16                  7.648988              -0.000454
17 x17                  7.512412               0.000656
18 x18                  7.113664               0.001358
19 x19                  7.700205              -0.001621
20 x20                  8.190782              -0.001130
21 x21                  7.126028               0.001344
22 x22                  0.183855              -0.018522
23 x23                  0.180157               0.002961
24 x24                  0.233848              -0.007105
25 x25                  0.234764              -0.000161
26 x26                  0.017605              -0.013765

Value of Objective Function = 935.20632654

Quasi-likelihood SPA for  3Ps cod

Cohort model for years  1959 - 2001 , and ages   2 -  14

Cameron RV                  index for years 1972 to 1982 , and ages  2 to 14. Var =  Quadratic

Can RV Burgeo               index for years 1993 to 2001 , and ages  2 to 12. Var =  Quadratic

Can RV No Burgeo            index for years 1983 to 2001 , and ages  2 to 14. Var =  Quadratic

Sentinel gillnet            index for years 1995 to 2000 , and ages  3 to 10. Var =  Quadratic
```

Table 21. Cont'd.

```
Sentinel linetrawl             index for years 1995 to 2000 , and ages  3 to 10. Var =  Quadratic


Extended Deviance =  935.21 , df =  500 , #Parms =   26

Penalty =    0.00

Var scale =  Cameron RV                         0.418
             Can RV Burgeo                      0.810
             Can RV No Burgeo                   0.570
             Sentinel gillnet                   0.346
             Sentinel linetrawl                 0.300


Quadratic Var                       Beta Std. Err   95% L   95% U

Cameron RV                          1.202   0.054  1.081   1.336
Can RV Burgeo                       1.197   0.094  0.995   1.441
Can RV No Burgeo                    1.263   0.063  1.116   1.431
Sentinel gillnet                    1.265   0.167  0.912   1.753
Sentinel linetrawl                  1.018   0.013  0.993   1.043

Age Survivors       CV     95% L     95% U

  2  82153.69     0.63 23700.22 284775.0
  3  60819.08     0.41 27471.00 134649.6
  4  35616.52     0.31 19229.01 65969.95
  5  10415.78     0.28  6042.15 17955.26
  6   7107.34     0.28  4086.81 12360.33
  7   4271.73     0.31  2333.83  7818.74
  8   2098.52     0.40   966.83  4554.88
  9   1830.62     0.40   838.96  3994.44
 10   1228.64     0.40   565.45  2669.65
 11   2208.80     0.41   997.68  4890.16
 12   3607.54     0.36  1784.00  7295.07
 13   1243.93     0.36   616.31  2510.68
```

Table 21. Cont'd.

```
Year Effect Constraint   Effect      CV     95% L     95% U

.                          1.00       .      1.00      1.00


F Constraint            Estimate      CV  95% L  95% U

F10_ratio_in_1993          0.326  0.744  0.076  1.402
F11_ratio_in_1993          0.279  0.547  0.096  0.814
F12_ratio_in_1993          0.199  0.660  0.055  0.726
F13_ratio_in_1993          0.343  0.637  0.099  1.196
F14_ratio_in_1959-1993     0.432  0.091  0.362  0.517
F14_ratio_in_1998          0.108  0.511  0.040  0.294
F14_ratio_in_1999          0.563  0.417  0.249  1.274
F14_ratio_in_2000          0.375  0.301  0.208  0.676
F14_ratio_in_2001          0.196  0.257  0.118  0.323


Q_CONST                    Estm (x1000)   CV    95% L    95% L

Cameron_a=02                     0.0292 0.01   0.0182   0.0402
Cameron_a=03                     0.0463 0.01   0.0290   0.0636
Cameron_a=04                     0.1085 0.02   0.0689   0.1481
Cameron_a=05                     0.1574 0.03   0.0997   0.2150
Cameron_a=06                     0.1180 0.02   0.0730   0.1630
Cameron_a=07                     0.1228 0.02   0.0737   0.1719
Cameron_a=08                     0.1231 0.03   0.0694   0.1769
Cameron_a=09                     0.1580 0.04   0.0840   0.2320
Cameron_a=10                     0.1380 0.04   0.0596   0.2163
Cameron_a=11                     0.1119 0.04   0.0287   0.1952
Cameron_a=12                     0.1079 0.05   0.0116   0.2042
Cameron_a=13                     0.0803 0.05  -0.0189   0.1796
Cameron_a=14                     0.0536 0.05  -0.0378   0.1450
CanRV_B_a=02                     0.0410 0.01   0.0113   0.0707
CanRV_B_a=03                     0.4489 0.12   0.1999   0.6978
CanRV_B_a=04                     0.6417 0.18   0.2863   0.9971
CanRV_B_a=05                     0.8346 0.23   0.3721   1.2971
CanRV_B_a=06                     0.8127 0.23   0.3606   1.2647
CanRV_B_a=07                     0.9236 0.26   0.4074   1.4398
CanRV_B_a=08                     0.5607 0.16   0.2359   0.8855
CanRV_B_a=09                     0.3863 0.12   0.1471   0.6256
CanRV_B_a=10                     0.1648 0.06   0.0421   0.2875
CanRV_B_a=11                     0.2167 0.08   0.0555   0.3779
CanRV_B_a=12                     0.0713 0.04  -0.0065   0.1492
CanRV_NoB_Camp_a=13              0.0278 0.03  -0.0305   0.0862
CanRV_NoB_Camp_a=14              0.0223 0.03  -0.0389   0.0836
CanRV_NoB_Engl_a=13              0.0980 0.04   0.0233   0.1728
CanRV_NoB_Engl_a=14              0.1049 0.04   0.0173   0.1924
CanRV_NoB_a=02                   0.0607 0.02   0.0250   0.0964
CanRV_NoB_a=03                   0.1305 0.02   0.0898   0.1711
CanRV_NoB_a=04                   0.1333 0.02   0.0915   0.1751
```

Table 21. Cont'd.

| | | | | |
|---|---|---|---|---|
| CanRV_NoB_a=05 | 0.1964 | 0.03 | 0.1349 | 0.2580 |
| CanRV_NoB_a=06 | 0.2192 | 0.03 | 0.1497 | 0.2888 |
| CanRV_NoB_a=07 | 0.1881 | 0.03 | 0.1252 | 0.2510 |
| CanRV_NoB_a=08 | 0.2412 | 0.04 | 0.1574 | 0.3250 |
| CanRV_NoB_a=09 | 0.2401 | 0.04 | 0.1515 | 0.3288 |
| CanRV_NoB_a=10 | 0.1552 | 0.03 | 0.0890 | 0.2215 |
| CanRV_NoB_a=11 | 0.1419 | 0.03 | 0.0762 | 0.2076 |
| CanRV_NoB_a=12 | 0.1275 | 0.03 | 0.0598 | 0.1952 |
| Sent_gill_a=03 | 0.0005 | 0.00 | -0.0006 | 0.0016 |
| Sent_gill_a=04 | 0.0077 | 0.00 | 0.0012 | 0.0143 |
| Sent_gill_a=05 | 0.1795 | 0.04 | 0.0971 | 0.2619 |
| Sent_gill_a=06 | 0.4566 | 0.10 | 0.2545 | 0.6587 |
| Sent_gill_a=07 | 0.5320 | 0.12 | 0.2947 | 0.7693 |
| Sent_gill_a=08 | 0.3756 | 0.09 | 0.2027 | 0.5485 |
| Sent_gill_a=09 | 0.1399 | 0.04 | 0.0645 | 0.2153 |
| Sent_gill_a=10 | 0.0777 | 0.03 | 0.0257 | 0.1298 |
| Sent_line_a=03 | 0.0006 | 0.00 | 0.0004 | 0.0007 |
| Sent_line_a=04 | 0.0023 | 0.00 | 0.0018 | 0.0028 |
| Sent_line_a=05 | 0.0034 | 0.00 | 0.0026 | 0.0041 |
| Sent_line_a=06 | 0.0037 | 0.00 | 0.0029 | 0.0045 |
| Sent_line_a=07 | 0.0028 | 0.00 | 0.0021 | 0.0035 |
| Sent_line_a=08 | 0.0026 | 0.00 | 0.0019 | 0.0033 |
| Sent_line_a=09 | 0.0015 | 0.00 | 0.0010 | 0.0020 |
| Sent_line_a=10 | 0.0006 | 0.00 | 0.0002 | 0.0009 |

Table 21. Cont'd.

Population Numbers at age

| | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 2+ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1959 | 77734 | 60717 | 118E3 | 45375 | 24344 | 16915 | 6388 | 4144 | 4527 | 6868 | 1726 | 428 | 12 | 367118 |
| 1960 | 63994 | 63643 | 48805 | 83946 | 30341 | 13358 | 9438 | 4378 | 2260 | 2566 | 5052 | 920 | 311 | 329012 |
| 1961 | 60762 | 52394 | 51593 | 34985 | 47281 | 18766 | 7791 | 4575 | 2661 | 1102 | 1734 | 3768 | 497 | 287910 |
| 1962 | 53241 | 49748 | 42489 | 37187 | 19272 | 24269 | 12092 | 2144 | 2072 | 934 | 499 | 1180 | 2578 | 247705 |
| 1963 | 86795 | 43590 | 39604 | 28680 | 22300 | 11677 | 14699 | 8663 | 1040 | 1180 | 595 | 282 | 844 | 259948 |
| 1964 | 101E3 | 71062 | 34819 | 28354 | 17065 | 13484 | 7274 | 9293 | 6280 | 587 | 837 | 398 | 134 | 290416 |
| 1965 | 105E3 | 82552 | 56456 | 23273 | 18115 | 9286 | 8375 | 4253 | 5897 | 4552 | 174 | 387 | 277 | 318979 |
| 1966 | 122E3 | 86279 | 65494 | 37503 | 13807 | 11566 | 4658 | 4998 | 2380 | 3894 | 3431 | 81 | 207 | 356146 |
| 1967 | 87902 | 99761 | 69780 | 41260 | 18883 | 7123 | 4838 | 2379 | 2433 | 1009 | 2720 | 2457 | 37 | 340582 |
| 1968 | 70026 | 71968 | 79080 | 47257 | 22109 | 9677 | 3706 | 2727 | 1401 | 1706 | 482 | 2141 | 1877 | 314156 |
| 1969 | 43906 | 57333 | 57888 | 53342 | 26805 | 12805 | 4690 | 1851 | 1736 | 762 | 1196 | 294 | 1748 | 264358 |
| 1970 | 75294 | 35947 | 46240 | 40972 | 33191 | 15452 | 6363 | 2250 | 799 | 772 | 569 | 871 | 180 | 258900 |
| 1971 | 50700 | 61646 | 28747 | 30516 | 21858 | 18340 | 6883 | 2987 | 1182 | 460 | 471 | 396 | 603 | 224791 |
| 1972 | 42330 | 41510 | 47862 | 17705 | 17226 | 11322 | 7580 | 2802 | 1292 | 478 | 300 | 273 | 268 | 190948 |
| 1973 | 51860 | 34657 | 33324 | 34712 | 10342 | 10890 | 5104 | 3821 | 1541 | 639 | 206 | 140 | 180 | 187414 |
| 1974 | 74066 | 42459 | 27519 | 23024 | 18118 | 4839 | 5276 | 2188 | 1301 | 795 | 368 | 69 | 102 | 200125 |
| 1975 | 82289 | 60640 | 33055 | 17064 | 9814 | 9074 | 1663 | 2640 | 751 | 579 | 426 | 229 | 28 | 218252 |
| 1976 | 101E3 | 67372 | 47983 | 20432 | 9087 | 3926 | 2121 | 708 | 1079 | 520 | 316 | 302 | 182 | 255304 |
| 1977 | 59017 | 82918 | 51441 | 28302 | 9559 | 4839 | 2034 | 1288 | 453 | 835 | 411 | 240 | 243 | 241579 |
| 1978 | 34091 | 48319 | 67041 | 33832 | 15638 | 4923 | 3129 | 1308 | 815 | 265 | 632 | 297 | 168 | 210458 |
| 1979 | 49582 | 27911 | 39106 | 50233 | 22183 | 9178 | 2444 | 1971 | 858 | 506 | 152 | 493 | 228 | 204846 |
| 1980 | 86769 | 40595 | 22730 | 29238 | 31788 | 13578 | 5385 | 1349 | 1403 | 626 | 366 | 102 | 392 | 234322 |
| 1981 | 54474 | 71041 | 32903 | 17139 | 19365 | 18646 | 8059 | 3275 | 808 | 1045 | 462 | 259 | 65 | 227542 |
| 1982 | 87807 | 44600 | 57238 | 24326 | 11195 | 11645 | 9968 | 5131 | 2193 | 504 | 795 | 347 | 196 | 255945 |
| 1983 | 80065 | 71891 | 36398 | 42255 | 15908 | 7041 | 6946 | 5502 | 3622 | 1576 | 337 | 624 | 274 | 272437 |
| 1984 | 68634 | 65551 | 58171 | 27373 | 26295 | 9332 | 4179 | 4646 | 3563 | 2744 | 1208 | 243 | 495 | 272435 |
| 1985 | 33059 | 56193 | 53485 | 43536 | 18305 | 15178 | 5631 | 2893 | 3313 | 2611 | 2126 | 957 | 191 | 237479 |
| 1986 | 44426 | 27066 | 45869 | 41402 | 28377 | 10332 | 7684 | 3271 | 1802 | 2220 | 1818 | 1642 | 765 | 216675 |
| 1987 | 58549 | 36373 | 21883 | 32937 | 24620 | 13074 | 4584 | 4330 | 2090 | 1273 | 1663 | 1359 | 1273 | 204008 |
| 1988 | 63877 | 47935 | 29251 | 15242 | 16993 | 11323 | 5770 | 2472 | 2544 | 1403 | 907 | 1291 | 991 | 199997 |
| 1989 | 59766 | 52298 | 38400 | 19468 | 7981 | 8057 | 4705 | 3102 | 1454 | 1826 | 1037 | 675 | 1009 | 199778 |
| 1990 | 27844 | 48933 | 41849 | 23300 | 8844 | 3944 | 4290 | 2846 | 1997 | 988 | 1367 | 798 | 526 | 167525 |
| 1991 | 53149 | 22797 | 38248 | 26461 | 11662 | 4228 | 1887 | 2393 | 1704 | 1318 | 681 | 1025 | 610 | 166163 |
| 1992 | 29069 | 43515 | 17930 | 24093 | 12591 | 4203 | 1504 | 815 | 1398 | 1008 | 981 | 489 | 794 | 138389 |
| 1993 | 16743 | 23800 | 34340 | 10916 | 12103 | 4393 | 1391 | 636 | 424 | 971 | 656 | 728 | 369 | 107470 |
| 1994 | 26006 | 13708 | 19234 | 24757 | 7096 | 7054 | 2390 | 776 | 440 | 312 | 748 | 525 | 584 | 103629 |
| 1995 | 19667 | 21292 | 11215 | 15677 | 20113 | 5743 | 5719 | 1931 | 624 | 358 | 254 | 613 | 430 | 103634 |
| 1996 | 18063 | 16102 | 17430 | 9176 | 12785 | 16359 | 4650 | 4649 | 1575 | 509 | 293 | 208 | 501 | 102299 |
| 1997 | 18458 | 14788 | 13175 | 14231 | 7474 | 10376 | 13281 | 3776 | 3784 | 1282 | 415 | 239 | 170 | 101448 |
| 1998 | 19598 | 15112 | 12048 | 10400 | 10629 | 5669 | 7647 | 10126 | 2922 | 3014 | 1022 | 336 | 195 | 98718 |
| 1999 | 53237 | 16045 | 12290 | 9527 | 7798 | 7300 | 3784 | 5072 | 7189 | 2189 | 2359 | 786 | 262 | 127836 |
| 2000 | 74285 | 43586 | 13092 | 9494 | 6712 | 4433 | 3877 | 2175 | 3284 | 5096 | 1621 | 1832 | 624 | 170112 |
| 2001 | 82154 | 60819 | 35617 | 10416 | 7107 | 4272 | 2099 | 1831 | 1229 | 2209 | 3608 | 1244 | 1466 | 214068 |
| 2001.3 | 78147 | 57853 | 33857 | 9865 | 6704 | 3914 | 1855 | 1640 | 1109 | 2031 | 3350 | 1165 | 1388 | 202878 |

Table 21. Cont'd.

Fishing Mortalities

| | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1959 | 0.000 | 0.018 | 0.140 | 0.202 | 0.400 | 0.383 | 0.178 | 0.406 | 0.368 | 0.107 | 0.429 | 0.121 | 0.095 |
| 1960 | 0.000 | 0.010 | 0.133 | 0.374 | 0.280 | 0.339 | 0.524 | 0.298 | 0.518 | 0.192 | 0.093 | 0.415 | 0.101 |
| 1961 | 0.000 | 0.010 | 0.127 | 0.396 | 0.467 | 0.239 | 1.090 | 0.592 | 0.847 | 0.593 | 0.185 | 0.179 | 0.138 |
| 1962 | 0.000 | 0.028 | 0.193 | 0.311 | 0.301 | 0.301 | 0.133 | 0.524 | 0.363 | 0.250 | 0.371 | 0.135 | 0.109 |
| 1963 | 0.000 | 0.025 | 0.134 | 0.319 | 0.303 | 0.273 | 0.259 | 0.122 | 0.372 | 0.144 | 0.203 | 0.544 | 0.128 |
| 1964 | 0.000 | 0.030 | 0.203 | 0.248 | 0.409 | 0.276 | 0.337 | 0.255 | 0.122 | 1.017 | 0.570 | 0.163 | 0.252 |
| 1965 | 0.000 | 0.031 | 0.209 | 0.322 | 0.249 | 0.490 | 0.316 | 0.380 | 0.215 | 0.083 | 0.566 | 0.428 | 0.155 |
| 1966 | 0.000 | 0.012 | 0.262 | 0.486 | 0.462 | 0.672 | 0.472 | 0.520 | 0.659 | 0.159 | 0.134 | 0.575 | 0.125 |
| 1967 | 0.000 | 0.032 | 0.190 | 0.424 | 0.469 | 0.453 | 0.373 | 0.329 | 0.155 | 0.538 | 0.039 | 0.069 | 0.093 |
| 1968 | 0.000 | 0.018 | 0.194 | 0.367 | 0.346 | 0.524 | 0.494 | 0.252 | 0.408 | 0.155 | 0.294 | 0.003 | 0.065 |
| 1969 | 0.000 | 0.015 | 0.146 | 0.274 | 0.351 | 0.499 | 0.534 | 0.640 | 0.610 | 0.093 | 0.118 | 0.290 | 0.072 |
| 1970 | 0.000 | 0.024 | 0.216 | 0.428 | 0.393 | 0.609 | 0.556 | 0.444 | 0.351 | 0.294 | 0.162 | 0.167 | 0.090 |
| 1971 | 0.000 | 0.053 | 0.285 | 0.372 | 0.458 | 0.684 | 0.699 | 0.638 | 0.705 | 0.228 | 0.347 | 0.190 | 0.110 |
| 1972 | 0.000 | 0.020 | 0.121 | 0.338 | 0.259 | 0.597 | 0.485 | 0.398 | 0.504 | 0.642 | 0.564 | 0.216 | 0.205 |
| 1973 | 0.000 | 0.031 | 0.170 | 0.450 | 0.560 | 0.525 | 0.647 | 0.877 | 0.461 | 0.353 | 0.892 | 0.117 | 0.196 |
| 1974 | 0.000 | 0.050 | 0.278 | 0.653 | 0.491 | 0.868 | 0.493 | 0.869 | 0.611 | 0.425 | 0.275 | 0.717 | 0.204 |
| 1975 | 0.000 | 0.034 | 0.281 | 0.430 | 0.716 | 1.254 | 0.655 | 0.695 | 0.168 | 0.404 | 0.145 | 0.029 | 0.083 |
| 1976 | 0.000 | 0.070 | 0.328 | 0.560 | 0.430 | 0.458 | 0.298 | 0.247 | 0.056 | 0.037 | 0.076 | 0.015 | 0.018 |
| 1977 | 0.000 | 0.013 | 0.219 | 0.393 | 0.464 | 0.236 | 0.242 | 0.258 | 0.336 | 0.078 | 0.123 | 0.154 | 0.051 |
| 1978 | 0.000 | 0.012 | 0.089 | 0.222 | 0.333 | 0.500 | 0.262 | 0.221 | 0.276 | 0.358 | 0.048 | 0.065 | 0.068 |
| 1979 | 0.000 | 0.005 | 0.091 | 0.258 | 0.291 | 0.333 | 0.395 | 0.140 | 0.115 | 0.123 | 0.192 | 0.030 | 0.050 |
| 1980 | 0.000 | 0.010 | 0.082 | 0.212 | 0.333 | 0.322 | 0.298 | 0.312 | 0.094 | 0.104 | 0.146 | 0.257 | 0.073 |
| 1981 | 0.000 | 0.016 | 0.102 | 0.226 | 0.309 | 0.426 | 0.252 | 0.201 | 0.273 | 0.073 | 0.087 | 0.080 | 0.035 |
| 1982 | 0.000 | 0.003 | 0.103 | 0.225 | 0.264 | 0.317 | 0.394 | 0.148 | 0.131 | 0.201 | 0.043 | 0.036 | 0.040 |
| 1983 | 0.000 | 0.012 | 0.085 | 0.274 | 0.333 | 0.322 | 0.202 | 0.235 | 0.077 | 0.066 | 0.129 | 0.032 | 0.033 |
| 1984 | 0.000 | 0.003 | 0.090 | 0.202 | 0.350 | 0.305 | 0.168 | 0.138 | 0.111 | 0.055 | 0.033 | 0.037 | 0.018 |
| 1985 | 0.000 | 0.003 | 0.056 | 0.228 | 0.372 | 0.481 | 0.343 | 0.273 | 0.201 | 0.162 | 0.058 | 0.025 | 0.035 |
| 1986 | 0.000 | 0.013 | 0.131 | 0.320 | 0.575 | 0.613 | 0.374 | 0.248 | 0.148 | 0.089 | 0.091 | 0.055 | 0.034 |
| 1987 | 0.000 | 0.018 | 0.162 | 0.462 | 0.577 | 0.618 | 0.418 | 0.332 | 0.199 | 0.139 | 0.053 | 0.116 | 0.044 |
| 1988 | 0.000 | 0.022 | 0.207 | 0.447 | 0.546 | 0.678 | 0.421 | 0.331 | 0.132 | 0.102 | 0.096 | 0.046 | 0.035 |
| 1989 | 0.000 | 0.023 | 0.300 | 0.589 | 0.505 | 0.430 | 0.303 | 0.241 | 0.186 | 0.089 | 0.063 | 0.049 | 0.029 |
| 1990 | 0.000 | 0.046 | 0.258 | 0.492 | 0.538 | 0.537 | 0.384 | 0.313 | 0.215 | 0.173 | 0.088 | 0.067 | 0.047 |
| 1991 | 0.000 | 0.040 | 0.262 | 0.543 | 0.821 | 0.834 | 0.640 | 0.337 | 0.325 | 0.095 | 0.132 | 0.055 | 0.041 |
| 1992 | 0.000 | 0.037 | 0.296 | 0.488 | 0.853 | 0.906 | 0.661 | 0.454 | 0.165 | 0.230 | 0.098 | 0.080 | 0.059 |
| 1993 | 0.000 | 0.013 | 0.127 | 0.231 | 0.340 | 0.409 | 0.384 | 0.168 | 0.104 | 0.061 | 0.022 | 0.021 | 0.015 |
| 1994 | 0.000 | 0.001 | 0.004 | 0.008 | 0.012 | 0.010 | 0.013 | 0.017 | 0.008 | 0.007 | 0.000 | 0.000 | 0.000 |
| 1995 | 0.000 | 0.000 | 0.001 | 0.004 | 0.007 | 0.011 | 0.007 | 0.004 | 0.004 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1996 | 0.000 | 0.001 | 0.003 | 0.005 | 0.009 | 0.008 | 0.008 | 0.006 | 0.006 | 0.004 | 0.004 | 0.000 | 0.000 |
| 1997 | 0.000 | 0.005 | 0.036 | 0.092 | 0.076 | 0.105 | 0.071 | 0.056 | 0.028 | 0.027 | 0.011 | 0.005 | 0.000 |
| 1998 | 0.000 | 0.007 | 0.035 | 0.088 | 0.176 | 0.204 | 0.211 | 0.143 | 0.089 | 0.045 | 0.062 | 0.051 | 0.006 |
| 1999 | 0.000 | 0.003 | 0.058 | 0.150 | 0.365 | 0.433 | 0.354 | 0.235 | 0.144 | 0.100 | 0.053 | 0.030 | 0.034 |
| 2000 | 0.000 | 0.002 | 0.029 | 0.090 | 0.252 | 0.548 | 0.550 | 0.371 | 0.197 | 0.145 | 0.065 | 0.023 | 0.029 |
| 2001 | 0.000 | 0.000 | 0.001 | 0.004 | 0.008 | 0.037 | 0.073 | 0.060 | 0.053 | 0.034 | 0.024 | 0.016 | 0.005 |

Table 21. Cont'd.

Commercial catch

| | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1959 | 0.000 | 1001 | 13940 | 7525 | 7265 | 4875 | 942.0 | 1252 | 1260 | 631.0 | 545.0 | 44.00 | 1.000 |
| 1960 | 0.000 | 567.0 | 5496 | 23704 | 6714 | 3476 | 3484 | 1020 | 827.0 | 406.0 | 407.0 | 283.0 | 27.00 |
| 1961 | 0.000 | 450.0 | 5586 | 10357 | 15960 | 3616 | 4680 | 1849 | 1376 | 446.0 | 265.0 | 560.0 | 58.00 |
| 1962 | 0.000 | 1245 | 6749 | 9003 | 4533 | 5715 | 1367 | 791.0 | 571.0 | 187.0 | 140.0 | 135.0 | 241.0 |
| 1963 | 0.000 | 961.0 | 4499 | 7091 | 5275 | 2527 | 3030 | 898.0 | 292.0 | 143.0 | 99.00 | 107.0 | 92.00 |
| 1964 | 0.000 | 1906 | 5785 | 5635 | 5179 | 2945 | 1881 | 1891 | 652.0 | 339.0 | 329.0 | 54.00 | 27.00 |
| 1965 | 0.000 | 2314 | 9636 | 5799 | 3609 | 3254 | 2055 | 1218 | 1033 | 327.0 | 68.00 | 122.0 | 36.00 |
| 1966 | 0.000 | 949.0 | 13662 | 13065 | 4621 | 5119 | 1586 | 1833 | 1039 | 517.0 | 389.0 | 32.00 | 22.00 |
| 1967 | 0.000 | 2871 | 10913 | 12900 | 6392 | 2349 | 1364 | 604.0 | 316.0 | 380.0 | 95.00 | 149.0 | 3.000 |
| 1968 | 0.000 | 1143 | 12602 | 13135 | 5853 | 3572 | 1308 | 549.0 | 425.0 | 222.0 | 111.0 | 5.000 | 107.0 |
| 1969 | 0.000 | 774.0 | 7098 | 11585 | 7178 | 4554 | 1757 | 792.0 | 717.0 | 61.00 | 120.0 | 67.00 | 110.0 |
| 1970 | 0.000 | 756.0 | 8114 | 12916 | 9763 | 6374 | 2456 | 730.0 | 214.0 | 178.0 | 77.00 | 121.0 | 14.00 |
| 1971 | 0.000 | 2884 | 6444 | 8574 | 7266 | 8218 | 3131 | 1275 | 541.0 | 85.00 | 125.0 | 62.00 | 57.00 |
| 1972 | 0.000 | 731.0 | 4944 | 4591 | 3552 | 4603 | 2636 | 833.0 | 463.0 | 205.0 | 117.0 | 48.00 | 45.00 |
| 1973 | 0.000 | 945.0 | 4707 | 11386 | 4010 | 4022 | 2201 | 2019 | 515.0 | 172.0 | 110.0 | 14.00 | 29.00 |
| 1974 | 0.000 | 1887 | 6042 | 9987 | 6365 | 2540 | 1857 | 1149 | 538.0 | 249.0 | 80.00 | 32.00 | 17.00 |
| 1975 | 0.000 | 1840 | 7329 | 5397 | 4541 | 5867 | 723.0 | 1196 | 105.0 | 174.0 | 52.00 | 6.000 | 2.000 |
| 1976 | 0.000 | 4110 | 12139 | 7923 | 2875 | 1305 | 495.0 | 140.0 | 53.00 | 17.00 | 21.00 | 4.000 | 3.000 |
| 1977 | 0.000 | 935.0 | 9156 | 8326 | 3209 | 920.0 | 395.0 | 265.0 | 117.0 | 57.00 | 43.00 | 31.00 | 11.00 |
| 1978 | 0.000 | 502.0 | 5146 | 6096 | 4006 | 1753 | 653.0 | 235.0 | 178.0 | 72.00 | 27.00 | 17.00 | 10.00 |
| 1979 | 0.000 | 135.0 | 3072 | 10321 | 5066 | 2353 | 721.0 | 233.0 | 84.00 | 53.00 | 24.00 | 13.00 | 10.00 |
| 1980 | 0.000 | 368.0 | 1625 | 5054 | 8156 | 3379 | 1254 | 327.0 | 114.0 | 56.00 | 45.00 | 21.00 | 25.00 |
| 1981 | 0.000 | 1022 | 2888 | 3136 | 4652 | 5855 | 1622 | 539.0 | 175.0 | 67.00 | 35.00 | 18.00 | 2.000 |
| 1982 | 0.000 | 130.0 | 5092 | 4430 | 2348 | 2861 | 2939 | 640.0 | 243.0 | 83.00 | 30.00 | 11.00 | 7.000 |
| 1983 | 0.000 | 760.0 | 2682 | 9174 | 4080 | 1752 | 1150 | 1041 | 244.0 | 91.00 | 37.00 | 18.00 | 8.000 |
| 1984 | 0.000 | 203.0 | 4521 | 4538 | 7018 | 2221 | 584.0 | 542.0 | 338.0 | 134.0 | 35.00 | 8.000 | 8.000 |
| 1985 | 0.000 | 152.0 | 2639 | 8031 | 5144 | 5242 | 1480 | 626.0 | 545.0 | 353.0 | 109.0 | 21.00 | 6.000 |
| 1986 | 0.000 | 306.0 | 5103 | 10253 | 11228 | 4283 | 2167 | 650.0 | 224.0 | 171.0 | 143.0 | 79.00 | 23.00 |
| 1987 | 0.000 | 585.0 | 2956 | 11023 | 9763 | 5453 | 1416 | 1107 | 341.0 | 149.0 | 78.00 | 135.0 | 50.00 |
| 1988 | 0.000 | 935.0 | 4951 | 4971 | 6471 | 5046 | 1793 | 630.0 | 284.0 | 123.0 | 75.00 | 53.00 | 31.00 |
| 1989 | 0.000 | 1071 | 8995 | 7842 | 2863 | 2549 | 1112 | 600.0 | 223.0 | 141.0 | 57.00 | 29.00 | 26.00 |
| 1990 | 0.000 | 2006 | 8622 | 8195 | 3329 | 1483 | 1237 | 692.0 | 350.0 | 142.0 | 104.0 | 47.00 | 22.00 |
| 1991 | 0.000 | 812.0 | 7981 | 10028 | 5907 | 2164 | 807.0 | 620.0 | 428.0 | 108.0 | 76.00 | 50.00 | 22.00 |
| 1992 | 0.000 | 1422 | 4159 | 8424 | 6538 | 2266 | 658.0 | 269.0 | 192.0 | 187.0 | 83.00 | 34.00 | 41.00 |
| 1993 | 0.000 | 278.0 | 3712 | 2035 | 3156 | 1334 | 401.0 | 89.00 | 38.00 | 52.00 | 13.00 | 14.00 | 5.000 |
| 1994 | 0.000 | 9.000 | 78.00 | 173.0 | 74.00 | 62.00 | 28.00 | 12.00 | 3.000 | 2.000 | 0.000 | 0.000 | 0.000 |
| 1995 | 0.000 | 3.000 | 7.000 | 56.00 | 119.0 | 57.00 | 37.00 | 7.000 | 2.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1996 | 0.000 | 9.000 | 43.00 | 43.00 | 101.0 | 125.0 | 35.00 | 24.00 | 8.000 | 2.000 | 1.000 | 0.000 | 0.000 |
| 1997 | 0.000 | 66.00 | 427.0 | 1130 | 497.0 | 937.0 | 826.0 | 187.0 | 93.00 | 31.00 | 4.000 | 1.000 | 0.000 |
| 1998 | 0.000 | 91.00 | 373.0 | 793.0 | 1550 | 948.0 | 1314 | 1217 | 225.0 | 120.0 | 56.00 | 15.00 | 1.000 |
| 1999 | 0.000 | 49.00 | 628.0 | 1202 | 2156 | 2321 | 1020 | 960.0 | 873.0 | 189.0 | 110.0 | 21.00 | 8.000 |
| 2000 | 0.690 | 76.24 | 335.3 | 735.8 | 1352 | 1692 | 1484 | 610.1 | 530.3 | 624.1 | 92.02 | 37.45 | 16.21 |
| 2001 | 0.000 | 0.291 | 23.37 | 43.97 | 58.09 | 153.1 | 144.6 | 103.6 | 61.72 | 71.49 | 83.65 | 18.85 | 6.832 |

Table 21. Cont'd.

Biomass at age

| | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 2+ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1959 | 0 | 10808 | 65102 | 39294 | 34228 | 35099 | 18142 | 15264 | 21110 | 38440 | 11270 | 3231 | 105 | 292093 |
| 1960 | 0 | 11328 | 21474 | 72446 | 40869 | 26822 | 26200 | 15883 | 10316 | 14205 | 32823 | 6909 | 2668 | 281943 |
| 1961 | 0 | 9326 | 22701 | 30192 | 63688 | 37682 | 21628 | 16597 | 12146 | 6101 | 11265 | 28286 | 4272 | 263884 |
| 1962 | 0 | 8855 | 18695 | 32092 | 25960 | 48733 | 33568 | 7779 | 9458 | 5169 | 3241 | 8857 | 22139 | 224546 |
| 1963 | 0 | 7759 | 17426 | 24751 | 30038 | 23448 | 40804 | 31431 | 4745 | 6532 | 3868 | 2116 | 7245 | 200162 |
| 1964 | 0 | 12649 | 15320 | 24469 | 22987 | 27077 | 20192 | 33715 | 28664 | 3249 | 5437 | 2987 | 1150 | 197895 |
| 1965 | 0 | 14694 | 24841 | 20084 | 24401 | 18646 | 23250 | 15431 | 26915 | 25195 | 1130 | 2908 | 2377 | 199873 |
| 1966 | 0 | 15358 | 28817 | 32365 | 18598 | 23225 | 12931 | 18132 | 10864 | 21551 | 22291 | 607 | 1776 | 206514 |
| 1967 | 0 | 17758 | 30703 | 35607 | 25436 | 14303 | 13429 | 8630 | 11105 | 5583 | 17672 | 18445 | 320 | 198991 |
| 1968 | 0 | 12810 | 34795 | 40783 | 29780 | 19430 | 10289 | 9892 | 6394 | 9444 | 3132 | 16073 | 16117 | 208938 |
| 1969 | 0 | 10205 | 25471 | 46035 | 36107 | 25712 | 13021 | 6715 | 7921 | 4220 | 7771 | 2208 | 15013 | 200399 |
| 1970 | 0 | 6399 | 20345 | 35359 | 44708 | 31027 | 17664 | 8164 | 3646 | 4274 | 3697 | 6536 | 1548 | 183367 |
| 1971 | 0 | 10973 | 12649 | 26335 | 29443 | 36827 | 19108 | 10838 | 5394 | 2548 | 3061 | 2975 | 5181 | 165332 |
| 1972 | 0 | 7389 | 21059 | 15280 | 23204 | 22734 | 21041 | 10167 | 5898 | 2647 | 1949 | 2047 | 2304 | 135718 |
| 1973 | 0 | 6169 | 14662 | 29957 | 13930 | 21867 | 14170 | 13861 | 7032 | 3537 | 1338 | 1049 | 1544 | 129116 |
| 1974 | 0 | 7558 | 12108 | 19870 | 24404 | 9716 | 14648 | 7937 | 5939 | 4403 | 2388 | 519 | 874 | 110363 |
| 1975 | 0 | 10794 | 14544 | 14726 | 13219 | 18221 | 4617 | 9577 | 3429 | 3202 | 2767 | 1716 | 237 | 97051 |
| 1976 | 0 | 12127 | 21113 | 17633 | 12241 | 7884 | 5887 | 2567 | 4925 | 2879 | 2054 | 2265 | 1560 | 93134 |
| 1977 | 0 | 40464 | 22428 | 26802 | 13545 | 10248 | 5826 | 4724 | 2037 | 4582 | 2621 | 1881 | 2280 | 137438 |
| 1978 | 0 | 18071 | 41566 | 28994 | 23582 | 10510 | 8840 | 4897 | 3790 | 1338 | 4129 | 2151 | 1473 | 149340 |
| 1979 | 0 | 8625 | 21156 | 42246 | 29614 | 19385 | 7340 | 7068 | 4425 | 3042 | 987 | 4087 | 2089 | 150064 |
| 1980 | 0 | 17131 | 12342 | 25057 | 41166 | 27468 | 16318 | 6013 | 7670 | 4308 | 2850 | 896 | 3747 | 164966 |
| 1981 | 0 | 26924 | 21091 | 16711 | 27614 | 36434 | 22953 | 12974 | 4477 | 7502 | 3752 | 2208 | 612 | 183253 |
| 1982 | 0 | 14673 | 34801 | 23377 | 17162 | 24001 | 25658 | 18348 | 10523 | 2983 | 6356 | 3065 | 1918 | 182865 |
| 1983 | 0 | 31129 | 22385 | 42763 | 24275 | 15089 | 19267 | 18129 | 16076 | 9274 | 2436 | 5811 | 2768 | 209401 |
| 1984 | 0 | 38151 | 45199 | 29672 | 42571 | 21390 | 13036 | 18282 | 16310 | 15105 | 9302 | 2360 | 5059 | 256437 |
| 1985 | 0 | 32423 | 40061 | 49239 | 28977 | 35714 | 16972 | 12586 | 17703 | 15220 | 13963 | 9014 | 2073 | 273946 |
| 1986 | 0 | 12234 | 31512 | 41444 | 42680 | 21553 | 22859 | 12581 | 9472 | 13537 | 13272 | 12482 | 8266 | 241892 |
| 1987 | 0 | 16841 | 14114 | 31389 | 34148 | 26959 | 12418 | 15991 | 9798 | 7435 | 10928 | 10681 | 10428 | 201129 |
| 1988 | 0 | 26652 | 19832 | 13961 | 24164 | 21299 | 14985 | 8127 | 11812 | 7510 | 5805 | 9313 | 7874 | 171334 |
| 1989 | 0 | 28189 | 27418 | 18982 | 10638 | 15615 | 12722 | 10744 | 6260 | 10217 | 6636 | 4828 | 8140 | 160389 |
| 1990 | 0 | 24956 | 30801 | 23627 | 12956 | 7879 | 11146 | 10732 | 9132 | 5669 | 9452 | 6212 | 4720 | 157280 |
| 1991 | 0 | 12721 | 25243 | 26541 | 17341 | 8854 | 5038 | 7962 | 7199 | 7487 | 4754 | 8307 | 5486 | 136932 |
| 1992 | 0 | 16405 | 11565 | 21250 | 17011 | 8271 | 3937 | 2828 | 6324 | 5251 | 6910 | 4366 | 8045 | 112163 |
| 1993 | 0 | 5569 | 19196 | 9443 | 14996 | 8004 | 3486 | 2253 | 1788 | 4948 | 4549 | 5329 | 3418 | 82979 |
| 1994 | 0 | 7197 | 10348 | 23296 | 10041 | 12302 | 5776 | 2471 | 1918 | 1625 | 4513 | 3745 | 4339 | 87569 |
| 1995 | 0 | 8048 | 8120 | 17746 | 32703 | 12307 | 13668 | 5953 | 2454 | 1546 | 1299 | 4036 | 3405 | 111286 |
| 1996 | 0 | 9403 | 12480 | 10304 | 22923 | 37037 | 12533 | 13937 | 5880 | 2319 | 1309 | 1142 | 3734 | 133001 |
| 1997 | 0 | 7098 | 10250 | 16124 | 12458 | 23522 | 37996 | 12063 | 12772 | 5513 | 2300 | 1513 | 1502 | 143112 |
| 1998 | 0 | 7692 | 9554 | 12345 | 17379 | 12064 | 21328 | 36645 | 11063 | 12162 | 4994 | 2145 | 1774 | 149146 |
| 1999 | 0 | 9932 | 9279 | 12051 | 14846 | 16622 | 9883 | 17681 | 33329 | 9937 | 11641 | 4444 | 1784 | 151429 |
| 2000 | 0 | 22055 | 10369 | 10614 | 12089 | 11154 | 10343 | 6483 | 13940 | 30056 | 8961 | 10659 | 4302 | 151026 |
| 2001 | 0 | 26760 | 26641 | 11832 | 11194 | 9359 | 5836 | 5389 | 4063 | 10333 | 25469 | 8174 | 10556 | 155607 |
| 2001.3 | 0 | 25455 | 25325 | 11207 | 10559 | 8576 | 5159 | 4829 | 3666 | 9503 | 23651 | 7654 | 9993 | 145577 |

Table 21. Cont'd.

Spawner Biomass at age

| | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 2+ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1959 | 0 | 43 | 924 | 2656 | 6626 | 16486 | 13734 | 13941 | 20525 | 38109 | 11240 | 3228 | 105 | 127618 |
| 1960 | 0 | 29 | 320 | 4426 | 7360 | 12598 | 19833 | 14505 | 10030 | 14083 | 32734 | 6904 | 2667 | 125492 |
| 1961 | 0 | 1 | 254 | 1615 | 14438 | 15058 | 16372 | 15158 | 11810 | 6049 | 11234 | 28263 | 4270 | 124523 |
| 1962 | 0 | 12 | 19 | 1486 | 4520 | 27744 | 22444 | 7104 | 9196 | 5124 | 3233 | 8850 | 22133 | 111863 |
| 1963 | 0 | 27 | 178 | 275 | 5193 | 10324 | 34941 | 27015 | 4614 | 6476 | 3857 | 2114 | 7243 | 102257 |
| 1964 | 0 | 35 | 283 | 1918 | 2522 | 12829 | 15061 | 32504 | 27196 | 3221 | 5422 | 2984 | 1149 | 105126 |
| 1965 | 0 | 68 | 440 | 1834 | 10063 | 10706 | 18484 | 14141 | 26695 | 24754 | 1127 | 2906 | 2377 | 113594 |
| 1966 | 0 | 43 | 726 | 3369 | 6489 | 19806 | 12111 | 17107 | 10604 | 21512 | 22162 | 606 | 1775 | 116311 |
| 1967 | 0 | 18 | 488 | 4465 | 10899 | 10596 | 13154 | 8577 | 10953 | 5547 | 17665 | 18410 | 320 | 101091 |
| 1968 | 0 | 1 | 230 | 3450 | 13202 | 16100 | 9655 | 9867 | 6390 | 9414 | 3126 | 16071 | 16107 | 103613 |
| 1969 | 0 | 45 | 31 | 2016 | 12323 | 20968 | 12616 | 6634 | 7919 | 4220 | 7765 | 2207 | 15013 | 91758 |
| 1970 | 0 | 42 | 417 | 460 | 10703 | 23258 | 16972 | 8124 | 3637 | 4274 | 3697 | 6535 | 1548 | 79666 |
| 1971 | 0 | 13 | 436 | 2365 | 3798 | 25179 | 18131 | 10759 | 5390 | 2547 | 3061 | 2975 | 5181 | 79836 |
| 1972 | 0 | 36 | 208 | 2474 | 7358 | 14200 | 19714 | 10081 | 5890 | 2646 | 1949 | 2047 | 2304 | 68906 |
| 1973 | 0 | 85 | 377 | 2352 | 7118 | 15003 | 13450 | 13727 | 7022 | 3536 | 1338 | 1049 | 1544 | 66600 |
| 1974 | 0 | 149 | 727 | 2470 | 10247 | 8256 | 13350 | 7899 | 5930 | 4402 | 2388 | 519 | 874 | 57210 |
| 1975 | 0 | 100 | 1012 | 3341 | 5727 | 15674 | 4471 | 9384 | 3428 | 3201 | 2767 | 1716 | 237 | 51059 |
| 1976 | 0 | 81 | 781 | 3833 | 7031 | 6342 | 5776 | 2552 | 4903 | 2879 | 2054 | 2265 | 1560 | 40058 |
| 1977 | 0 | 32 | 628 | 3648 | 6878 | 8827 | 5575 | 4714 | 2035 | 4578 | 2621 | 1881 | 2280 | 43696 |
| 1978 | 0 | 54 | 241 | 3178 | 9261 | 8335 | 8541 | 4856 | 3789 | 1338 | 4129 | 2151 | 1473 | 47344 |
| 1979 | 0 | 91 | 372 | 1762 | 10205 | 14079 | 6858 | 7015 | 4418 | 3042 | 987 | 4087 | 2089 | 55006 |
| 1980 | 0 | 7 | 494 | 2413 | 10053 | 19005 | 14946 | 5901 | 7657 | 4307 | 2850 | 896 | 3747 | 72276 |
| 1981 | 0 | 127 | 101 | 2323 | 10725 | 25708 | 20786 | 12690 | 4454 | 7499 | 3752 | 2208 | 612 | 90986 |
| 1982 | 0 | 493 | 961 | 1304 | 6606 | 18985 | 24293 | 17911 | 10467 | 2979 | 6356 | 3065 | 1918 | 95336 |
| 1983 | 0 | 184 | 1988 | 6213 | 10200 | 10684 | 18450 | 17993 | 15985 | 9262 | 2435 | 5811 | 2768 | 101974 |
| 1984 | 0 | 46 | 1085 | 6365 | 21499 | 19227 | 11783 | 18147 | 16294 | 15085 | 9299 | 2359 | 5059 | 126247 |
| 1985 | 0 | 23 | 264 | 4579 | 12559 | 30700 | 16818 | 12250 | 17682 | 15219 | 13959 | 9013 | 2073 | 135139 |
| 1986 | 0 | 24 | 161 | 1513 | 12770 | 14695 | 22253 | 12572 | 9406 | 13535 | 13272 | 12481 | 8266 | 120947 |
| 1987 | 0 | 20 | 186 | 1158 | 6082 | 17259 | 10645 | 15919 | 9797 | 7421 | 10928 | 10681 | 10428 | 100524 |
| 1988 | 0 | 11 | 220 | 1141 | 5374 | 11785 | 13203 | 7671 | 11803 | 7510 | 5802 | 9313 | 7874 | 81706 |
| 1989 | 0 | 51 | 145 | 1799 | 3952 | 10629 | 11147 | 10407 | 6129 | 10216 | 6636 | 4828 | 8140 | 74081 |
| 1990 | 0 | 142 | 718 | 1729 | 6398 | 6280 | 10486 | 10473 | 9062 | 5626 | 9452 | 6212 | 4720 | 71298 |
| 1991 | 0 | 42 | 1303 | 6372 | 9362 | 7977 | 4852 | 7896 | 7168 | 7473 | 4741 | 8307 | 5486 | 70978 |
| 1992 | 0 | 259 | 586 | 7250 | 13729 | 7823 | 3891 | 2812 | 6317 | 5247 | 6908 | 4362 | 8045 | 67229 |
| 1993 | 0 | 117 | 1835 | 4354 | 12466 | 7862 | 3473 | 2250 | 1786 | 4948 | 4548 | 5329 | 3416 | 52385 |
| 1994 | 0 | 4 | 1177 | 9556 | 9358 | 12044 | 5767 | 2470 | 1918 | 1625 | 4513 | 3745 | 4339 | 56515 |
| 1995 | 0 | 61 | 126 | 7695 | 26839 | 12252 | 13638 | 5953 | 2454 | 1546 | 1299 | 4036 | 3405 | 79304 |
| 1996 | 0 | 154 | 910 | 3637 | 18808 | 35848 | 12529 | 13934 | 5880 | 2319 | 1309 | 1142 | 3734 | 100205 |
| 1997 | 0 | 236 | 951 | 7219 | 11834 | 22691 | 37806 | 12063 | 12772 | 5513 | 2300 | 1513 | 1502 | 116401 |
| 1998 | 0 | 172 | 1337 | 4757 | 15521 | 12046 | 21198 | 36616 | 11063 | 12162 | 4994 | 2145 | 1774 | 123785 |
| 1999 | 0 | 105 | 789 | 5231 | 11781 | 16431 | 9883 | 17663 | 33325 | 9937 | 11641 | 4444 | 1784 | 123014 |
| 2000 | 0 | 487 | 675 | 2909 | 9471 | 10700 | 10331 | 6483 | 13937 | 30056 | 8961 | 10659 | 4302 | 108974 |
| 2001 | 0 | 591 | 2576 | 3683 | 6777 | 8841 | 5796 | 5389 | 4063 | 10333 | 25469 | 8174 | 10556 | 92248 |
| 2001.3 | 0 | 563 | 2449 | 3489 | 6392 | 8101 | 5124 | 4829 | 3666 | 9503 | 23651 | 7654 | 9993 | 85412 |

Table 21. Cont'd.

Standardized Cameron RV                    Resdiuals; MSE=   1.01

| | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1972.2 | 0.03 | 0.07 | -0.63 | -0.66 | -0.91 | 0.06 | 0.42 | 0.38 | 0.33 | 1.68 | -0.17 | -0.26 | -0.10 |
| 1973.2 | 0.15 | 0.31 | -0.45 | -1.08 | -1.39 | -1.36 | -1.44 | -1.40 | -0.67 | -0.70 | 0.06 | -0.02 | -0.35 |
| 1974.3 | 2.02 | 2.21 | -0.59 | -0.46 | 0.32 | 0.81 | -0.57 | 0.30 | -0.08 | 0.31 | 0.11 | -0.24 | 1.35 |
| 1975.4 | -1.17 | -0.51 | -1.01 | -1.16 | -0.50 | -0.15 | 0.64 | -0.72 | -0.41 | -0.46 | -0.69 | 0.37 | -0.14 |
| 1976.4 | 0.19 | -0.35 | -0.07 | 0.00 | 0.56 | 0.84 | 2.14 | 0.78 | -0.27 | 0.25 | 1.20 | -0.53 | -0.35 |
| 1977.3 | -1.07 | 0.50 | -0.31 | -0.62 | -0.09 | -0.47 | -0.11 | 1.52 | 0.54 | -0.71 | -0.00 | 0.07 | -0.40 |
| 1978.2 | -0.56 | -0.73 | -0.89 | -1.49 | -1.27 | -0.87 | -0.54 | -0.12 | 0.56 | 0.29 | -0.84 | -0.54 | -0.34 |
| 1979.2 | -0.81 | -0.19 | 4.54 | 4.14 | 0.23 | -0.92 | -0.56 | -0.68 | 0.17 | -0.05 | -0.15 | -0.50 | 0.29 |
| 1980.2 | 2.07 | -0.32 | -0.88 | -0.14 | -0.24 | -1.01 | -0.24 | -0.01 | -0.14 | 0.56 | 0.42 | 0.96 | -0.51 |
| 1981.2 | -0.84 | -0.19 | 0.50 | 2.24 | 3.52 | 2.86 | -0.25 | 0.93 | 1.15 | -0.83 | 0.99 | 1.55 | 1.73 |
| 1982.4 | -0.09 | -0.79 | -0.22 | -0.81 | -0.31 | 0.20 | 0.83 | -0.50 | -0.70 | 0.19 | -0.55 | -0.34 | 0.02 |

Unstandardized Cameron RV                    Resdiuals; MSE=   4.10

| | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1972.2 | 0.02 | 0.08 | -1.85 | -1.01 | -1.04 | 0.04 | 0.23 | 0.11 | 0.05 | 0.10 | -0.01 | -0.01 | -0.00 |
| 1973.2 | 0.14 | 0.30 | -0.93 | -3.11 | -0.94 | -1.01 | -0.53 | -0.48 | -0.11 | -0.05 | 0.00 | -0.00 | -0.01 |
| 1974.3 | 2.54 | 2.51 | -0.94 | -0.80 | 0.34 | 0.25 | -0.21 | 0.06 | -0.01 | 0.03 | 0.01 | -0.00 | 0.03 |
| 1975.4 | -1.60 | -0.80 | -1.82 | -1.50 | -0.26 | -0.06 | 0.08 | -0.16 | -0.04 | -0.03 | -0.04 | 0.01 | -0.00 |
| 1976.4 | 0.31 | -0.59 | -0.17 | 0.01 | 0.31 | 0.23 | 0.38 | 0.08 | -0.03 | 0.02 | 0.06 | -0.02 | -0.01 |
| 1977.3 | -1.08 | 1.09 | -0.92 | -1.40 | -0.05 | -0.17 | -0.02 | 0.23 | 0.04 | -0.07 | -0.00 | 0.00 | -0.01 |
| 1978.2 | -0.35 | -0.97 | -3.64 | -4.39 | -1.32 | -0.32 | -0.14 | -0.02 | 0.06 | 0.01 | -0.06 | -0.02 | -0.01 |
| 1979.2 | -0.71 | -0.15 | 10.98 | 17.84 | 0.34 | -0.60 | -0.12 | -0.15 | 0.02 | -0.00 | -0.01 | -0.03 | 0.01 |
| 1980.2 | 3.10 | -0.36 | -1.26 | -0.36 | -0.50 | -0.95 | -0.10 | -0.00 | -0.02 | 0.04 | 0.02 | 0.02 | -0.02 |
| 1981.2 | -0.81 | -0.36 | 1.01 | 3.40 | 4.49 | 3.58 | -0.15 | 0.31 | 0.12 | -0.09 | 0.06 | 0.06 | 0.03 |
| 1982.4 | -0.13 | -0.93 | -0.73 | -1.60 | -0.22 | 0.15 | 0.52 | -0.24 | -0.15 | 0.01 | -0.05 | -0.02 | 0.00 |

Cameron RV                    Index

| | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1972.2 | 1.21 | 1.92 | 3.02 | 1.49 | 0.81 | 1.23 | 1.04 | 0.50 | 0.20 | 0.15 | 0.02 | 0.01 | 0.01 |
| 1973.2 | 1.59 | 1.83 | 2.43 | 1.69 | 0.11 | 0.15 | 0.00 | 0.01 | 0.08 | 0.01 | 0.02 | 0.01 | 0.00 |
| 1974.3 | 4.58 | 4.33 | 1.65 | 2.01 | 2.08 | 0.68 | 0.32 | 0.31 | 0.13 | 0.10 | 0.04 | 0.00 | 0.03 |
| 1975.4 | 0.62 | 1.76 | 1.14 | 0.59 | 0.54 | 0.56 | 0.23 | 0.13 | 0.05 | 0.02 | 0.00 | 0.03 | 0.00 |
| 1976.4 | 3.04 | 2.21 | 4.04 | 2.38 | 1.14 | 0.60 | 0.59 | 0.17 | 0.10 | 0.07 | 0.09 | 0.00 | 0.00 |
| 1977.3 | 0.54 | 4.69 | 4.00 | 2.33 | 0.87 | 0.35 | 0.20 | 0.41 | 0.09 | 0.02 | 0.04 | 0.02 | 0.00 |
| 1978.2 | 0.61 | 1.18 | 3.22 | 0.50 | 0.34 | 0.21 | 0.21 | 0.17 | 0.16 | 0.04 | 0.00 | 0.00 | 0.00 |
| 1979.2 | 0.68 | 1.09 | 14.98 | 25.05 | 2.71 | 0.41 | 0.15 | 0.14 | 0.13 | 0.05 | 0.01 | 0.01 | 0.02 |
| 1980.2 | 5.53 | 1.44 | 1.07 | 3.88 | 2.87 | 0.55 | 0.50 | 0.19 | 0.16 | 0.11 | 0.06 | 0.03 | 0.00 |
| 1981.2 | 0.72 | 2.79 | 4.37 | 5.88 | 6.55 | 5.60 | 0.76 | 0.79 | 0.22 | 0.02 | 0.11 | 0.08 | 0.03 |
| 1982.4 | 2.24 | 0.97 | 4.77 | 1.63 | 0.88 | 1.31 | 1.49 | 0.47 | 0.12 | 0.06 | 0.03 | 0.01 | 0.01 |

Table 21. Cont'd.

Standardized Can RV Burgeo Resdiuals; MSE= 0.99

| | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1993.3 | 0.00 | -0.80 | -0.72 | -0.24 | -0.20 | -0.58 | -0.20 | -0.04 | 0.25 | -0.20 | -0.52 |
| 1994.3 | 0.00 | -0.20 | -0.20 | -0.23 | 0.70 | 0.03 | 1.47 | 0.76 | 0.83 | 0.15 | 0.11 |
| 1995.3 | 0.00 | -0.86 | -0.71 | -0.99 | -0.97 | -0.88 | -0.37 | -0.19 | -0.12 | -0.11 | 0.66 |
| 1996.3 | 1.03 | 0.65 | 0.23 | -0.39 | -0.48 | -0.69 | -0.61 | -0.13 | -0.79 | 0.46 | -0.37 |
| 1997.3 | -0.17 | -0.63 | -0.48 | -1.00 | -0.84 | -1.06 | -1.04 | -0.53 | -0.85 | -0.74 | -0.43 |
| 1998.3 | -0.48 | 3.83 | 3.13 | 3.06 | 1.67 | 2.31 | 0.78 | -0.37 | -0.10 | 2.60 | -0.61 |
| 1999.3 | -0.52 | -0.40 | -0.17 | 0.52 | -0.39 | -0.36 | -0.83 | -0.63 | -0.91 | -0.47 | 1.16 |
| 2000.3 | -0.89 | -0.93 | -0.20 | -0.12 | 0.76 | 1.06 | 0.14 | 0.37 | -0.85 | -1.11 | 0.29 |
| 2001 | 1.05 | -0.64 | -0.86 | -0.61 | -0.24 | 0.19 | 0.74 | 0.98 | 3.59 | -0.53 | -0.52 |

Unstandardized Can RV Burgeo Resdiuals; MSE= 29.85

| | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1993.3 | 0.00 | -6.65 | -11.9 | -1.57 | -1.43 | -1.65 | -0.12 | -0.01 | 0.03 | -0.04 | -0.04 |
| 1994.3 | 0.00 | -0.95 | -1.88 | -3.65 | 3.19 | 0.14 | 1.63 | 0.23 | 0.09 | 0.02 | 0.01 |
| 1995.3 | 0.00 | -6.40 | -4.03 | -10.0 | -12.3 | -3.66 | -0.94 | -0.12 | -0.02 | -0.01 | 0.03 |
| 1996.3 | 0.67 | 3.67 | 1.97 | -2.33 | -3.92 | -8.08 | -1.28 | -0.19 | -0.21 | 0.07 | -0.02 |
| 1997.3 | -0.11 | -3.30 | -3.15 | -9.05 | -3.93 | -7.72 | -5.94 | -0.63 | -0.47 | -0.21 | -0.03 |
| 1998.3 | -0.34 | 20.36 | 18.78 | 20.26 | 10.74 | 9.01 | 2.49 | -1.10 | -0.04 | 1.49 | -0.07 |
| 1999.3 | -0.92 | -2.28 | -1.06 | 3.11 | -1.74 | -1.68 | -1.30 | -0.94 | -0.87 | -0.20 | 0.22 |
| 2000.3 | -2.16 | -14.1 | -1.28 | -0.74 | 3.05 | 2.93 | 0.21 | 0.24 | -0.40 | -1.00 | 0.04 |
| 2001 | 2.85 | -13.6 | -15.4 | -4.16 | -1.10 | 0.58 | 0.69 | 0.59 | 0.78 | -0.23 | -0.14 |

Can RV Burgeo Index

| | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1993.3 | 0.00 | 3.37 | 8.04 | 6.44 | 6.94 | 1.73 | 0.53 | 0.21 | 0.09 | 0.15 | 0.00 |
| 1994.3 | 0.00 | 4.84 | 9.73 | 15.76 | 8.60 | 6.26 | 2.89 | 0.51 | 0.16 | 0.08 | 0.06 |
| 1995.3 | 0.49 | 2.60 | 2.75 | 2.26 | 3.03 | 1.32 | 2.07 | 0.58 | 0.08 | 0.06 | 0.05 |
| 1996.3 | 1.37 | 10.48 | 12.50 | 4.87 | 5.84 | 6.11 | 1.17 | 1.50 | 0.03 | 0.17 | 0.00 |
| 1997.3 | 0.60 | 2.94 | 4.73 | 1.83 | 1.66 | 1.02 | 0.92 | 0.72 | 0.11 | 0.05 | 0.00 |
| 1998.3 | 0.42 | 26.74 | 25.99 | 28.22 | 18.46 | 13.65 | 6.28 | 2.43 | 0.40 | 2.10 | 0.00 |
| 1999.3 | 1.14 | 4.50 | 6.24 | 10.27 | 3.61 | 3.90 | 0.50 | 0.78 | 0.20 | 0.23 | 0.38 |
| 2000.3 | 0.71 | 4.31 | 6.56 | 6.52 | 7.81 | 6.20 | 1.95 | 0.95 | 0.08 | 0.00 | 0.15 |
| 2001 | 6.05 | 12.35 | 6.32 | 4.07 | 4.35 | 4.20 | 1.73 | 1.22 | 0.96 | 0.21 | 0.10 |

Table 21. Cont'd.

Standardized Can RV No Burgeo Resdiuals; MSE= 1.07

| | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1983.3 | 0.00 | -0.36 | -1.10 | -0.80 | -0.77 | -0.84 | -0.51 | 0.72 | 0.71 | 1.02 | 1.52 | 0.03 | 0.73 |
| 1984.3 | 0.00 | -1.00 | -1.14 | -1.30 | -0.86 | -0.90 | -0.76 | -0.76 | 0.66 | -0.60 | 0.04 | 0.71 | -0.35 |
| 1985.2 | 0.00 | 1.41 | 1.15 | 0.01 | -0.28 | -0.42 | -0.85 | -0.52 | -0.64 | 0.11 | 0.54 | 0.92 | 1.23 |
| 1986.2 | 0.00 | 1.02 | -0.37 | -0.23 | -0.38 | -0.14 | -0.59 | -0.56 | -0.45 | -0.35 | 0.33 | -0.08 | -0.06 |
| 1987.2 | 0.00 | 0.45 | 1.27 | 2.00 | 1.16 | 0.44 | 0.14 | -0.57 | -0.51 | -0.16 | -0.25 | 0.71 | 0.55 |
| 1988.1 | 0.00 | 0.08 | -0.59 | -0.54 | 0.35 | 1.76 | 1.78 | 1.48 | 0.56 | 1.29 | 0.35 | -0.30 | 0.61 |
| 1989.1 | 0.00 | -0.53 | -0.86 | -1.14 | -0.95 | 0.03 | -0.01 | -0.31 | 0.38 | 0.28 | -0.12 | 0.36 | -0.41 |
| 1990.1 | 0.00 | -0.26 | 1.54 | 0.83 | 0.94 | 1.95 | 1.74 | -0.19 | -0.03 | 0.29 | -0.71 | -0.43 | -0.04 |
| 1991.1 | 0.00 | 0.73 | -0.55 | -0.10 | 0.31 | 0.93 | 1.93 | 0.57 | 2.94 | 1.25 | 1.53 | 0.17 | 0.39 |
| 1992.1 | 0.00 | -0.06 | -0.92 | -1.07 | -1.06 | -0.68 | -0.71 | -0.75 | -0.71 | -0.81 | -0.77 | -0.58 | -0.72 |
| 1993.1 | 0.00 | 0.00 | -0.40 | -0.58 | 0.10 | -0.54 | -1.07 | -0.95 | -0.76 | -1.10 | -1.09 | -0.75 | -0.82 |
| 1993.3 | -0.88 | -0.59 | -0.81 | -0.55 | -0.64 | -0.80 | -0.78 | -0.46 | -0.71 | -0.58 | -0.67 | -0.25 | -0.52 |
| 1994.3 | 0.00 | -0.78 | 0.30 | -0.27 | -0.76 | -0.56 | -0.84 | -0.89 | -0.35 | -0.42 | -0.67 | -0.47 | -0.52 |
| 1995.3 | 0.00 | -0.92 | -0.21 | 6.28 | 6.50 | 2.51 | 2.41 | 4.94 | 1.65 | 2.22 | -0.48 | 0.15 | -0.29 |
| 1996.3 | -0.07 | -0.01 | -0.19 | -0.88 | -0.45 | -0.25 | -0.89 | -1.13 | -0.57 | 0.02 | -0.22 | -0.21 | -0.29 |
| 1997.3 | 1.60 | -0.09 | -0.98 | -1.32 | -1.29 | -1.28 | -1.37 | -1.24 | -1.18 | -0.88 | -0.59 | -0.23 | -0.17 |
| 1998.3 | -0.36 | -0.01 | 0.50 | -0.14 | -0.68 | -0.42 | 0.74 | 0.46 | -0.41 | -0.95 | -0.56 | -0.27 | -0.18 |
| 1999.3 | -0.17 | -0.02 | -0.47 | 0.10 | 0.53 | 0.24 | -0.70 | -0.30 | -0.42 | -0.92 | -0.99 | 0.19 | -0.21 |
| 2000.3 | 0.00 | -0.03 | 0.37 | -0.72 | -0.43 | -0.28 | -0.22 | -0.48 | -0.16 | -0.02 | -0.46 | -0.58 | -0.08 |
| 2001 | -0.91 | 1.31 | 2.64 | 1.28 | -0.22 | -0.18 | 0.19 | 0.57 | -0.23 | 0.94 | 2.15 | 0.88 | 0.45 |

Unstandardized Can RV No Burgeo Resdiuals; MSE= 4.24

| | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1983.3 | 0.00 | -2.17 | -3.37 | -3.96 | -1.61 | -0.71 | -0.55 | 0.62 | 0.30 | 0.21 | 0.11 | 0.00 | 0.04 |
| 1984.3 | 0.00 | -5.52 | -5.52 | -4.27 | -2.89 | -0.99 | -0.52 | -0.58 | 0.28 | -0.19 | 0.01 | 0.04 | -0.03 |
| 1985.2 | 0.00 | 6.79 | 5.34 | 0.08 | -0.69 | -0.73 | -0.77 | -0.26 | -0.25 | 0.04 | 0.13 | 0.11 | 0.06 |
| 1986.2 | 0.00 | 2.41 | -1.47 | -1.15 | -1.40 | -0.17 | -0.70 | -0.32 | -0.11 | -0.10 | 0.07 | -0.01 | -0.01 |
| 1987.2 | 0.00 | 1.40 | 2.43 | 7.78 | 3.70 | 0.65 | 0.10 | -0.40 | -0.14 | -0.03 | -0.05 | 0.10 | 0.08 |
| 1988.1 | 0.00 | 0.32 | -1.54 | -1.06 | 0.85 | 2.46 | 1.71 | 0.68 | 0.19 | 0.26 | 0.05 | -0.04 | 0.08 |
| 1989.1 | 0.00 | -2.43 | -2.89 | -2.79 | -1.12 | 0.03 | -0.01 | -0.17 | 0.08 | 0.07 | -0.02 | 0.04 | -0.05 |
| 1990.1 | 0.00 | -1.09 | 5.64 | 2.44 | 1.22 | 1.06 | 1.28 | -0.10 | -0.01 | 0.04 | -0.13 | -0.05 | -0.00 |
| 1991.1 | 0.00 | 1.50 | -1.86 | -0.33 | 0.51 | 0.52 | 0.69 | 0.26 | 0.71 | 0.24 | 0.18 | 0.02 | 0.04 |
| 1992.1 | 0.00 | -0.22 | -1.48 | -3.28 | -1.86 | -0.38 | -0.21 | -0.14 | -0.15 | -0.13 | -0.11 | -0.05 | -0.08 |
| 1993.1 | 0.00 | 0.00 | -0.85 | -1.18 | 0.32 | -1.55 | -1.57 | -1.28 | -1.35 | -1.77 | -0.66 | -0.41 | -0.24 |
| 1993.3 | -0.23 | -0.10 | -0.13 | -0.05 | -0.06 | -0.12 | -0.12 | -0.05 | -0.08 | -0.06 | -0.07 | -0.02 | -0.04 |
| 1994.3 | 0.00 | -0.95 | 0.51 | -0.85 | -0.81 | -0.52 | -0.37 | -0.16 | -0.03 | -0.03 | -0.08 | -0.04 | -0.05 |
| 1995.3 | 0.00 | -1.70 | -0.22 | 12.75 | 18.67 | 1.92 | 2.30 | 1.83 | 0.20 | 0.18 | -0.03 | 0.01 | -0.02 |
| 1996.3 | -0.05 | -0.02 | -0.30 | -1.07 | -0.84 | -0.51 | -0.70 | -0.89 | -0.13 | 0.00 | -0.02 | -0.01 | -0.01 |
| 1997.3 | 1.26 | -0.11 | -1.16 | -2.39 | -1.42 | -1.64 | -2.84 | -0.80 | -0.53 | -0.16 | -0.05 | -0.01 | -0.00 |
| 1998.3 | -0.30 | -0.01 | 0.54 | -0.19 | -1.00 | -0.30 | 0.87 | 0.72 | -0.15 | -0.33 | -0.08 | -0.01 | -0.00 |
| 1999.3 | -0.36 | -0.03 | -0.52 | 0.13 | 0.56 | 0.20 | -0.42 | -0.24 | -0.32 | -0.24 | -0.26 | 0.01 | -0.01 |
| 2000.3 | 0.00 | -0.09 | 0.44 | -0.89 | -0.41 | -0.15 | -0.13 | -0.18 | -0.06 | -0.01 | -0.09 | -0.05 | -0.00 |
| 2001 | -2.96 | 6.76 | 8.24 | 1.77 | -0.24 | -0.11 | 0.07 | 0.20 | -0.04 | 0.25 | 0.78 | 0.06 | 0.03 |

Table 21. Cont'd.

Can RV No Burgeo Index

| | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1983.3 | 11.41 | 6.63 | 1.08 | 3.24 | 1.36 | 0.42 | 0.93 | 1.78 | 0.82 | 0.42 | 0.15 | 0.06 | 0.07 |
| 1984.3 | 5.77 | 2.53 | 1.59 | 0.50 | 2.00 | 0.52 | 0.38 | 0.43 | 0.78 | 0.17 | 0.15 | 0.06 | 0.02 |
| 1985.2 | 7.50 | 13.83 | 12.11 | 7.93 | 2.89 | 1.76 | 0.45 | 0.37 | 0.22 | 0.38 | 0.39 | 0.20 | 0.08 |
| 1986.2 | 5.76 | 5.79 | 4.25 | 6.18 | 3.93 | 1.48 | 0.95 | 0.40 | 0.15 | 0.20 | 0.29 | 0.14 | 0.07 |
| 1987.2 | 9.46 | 5.94 | 5.14 | 13.45 | 8.32 | 2.74 | 1.08 | 0.53 | 0.16 | 0.14 | 0.15 | 0.23 | 0.21 |
| 1988.1 | 10.13 | 6.44 | 2.20 | 1.75 | 4.31 | 4.41 | 3.02 | 1.24 | 0.57 | 0.45 | 0.16 | 0.08 | 0.18 |
| 1989.1 | 6.76 | 4.24 | 1.98 | 0.74 | 0.51 | 1.45 | 1.07 | 0.54 | 0.30 | 0.32 | 0.11 | 0.10 | 0.05 |
| 1990.1 | 1.51 | 5.14 | 10.97 | 6.71 | 3.02 | 1.75 | 2.26 | 0.55 | 0.29 | 0.18 | 0.04 | 0.03 | 0.05 |
| 1991.1 | 30.70 | 4.40 | 3.01 | 4.50 | 2.82 | 1.24 | 1.11 | 0.80 | 0.96 | 0.42 | 0.26 | 0.12 | 0.10 |
| 1992.1 | 1.92 | 5.32 | 0.79 | 1.14 | 0.62 | 0.33 | 0.12 | 0.04 | 0.06 | 0.01 | 0.01 | 0.00 | 0.00 |
| 1993.1 | 0.00 | 0.00 | 2.19 | 1.73 | 4.75 | 2.60 | 0.48 | 0.60 | 1.16 | 0.49 | 0.12 | 0.28 | 0.08 |
| 1993.3 | 0.05 | 0.05 | 0.01 | 0.01 | 0.00 | 0.01 | 0.01 | 0.03 | 0.00 | 0.01 | 0.00 | 0.02 | 0.00 |
| 1994.3 | 1.81 | 0.73 | 2.92 | 3.72 | 0.65 | 0.73 | 0.17 | 0.01 | 0.03 | 0.01 | 0.01 | 0.01 | 0.01 |
| 1995.3 | 0.24 | 0.92 | 1.19 | 15.65 | 22.81 | 2.93 | 3.60 | 2.27 | 0.29 | 0.23 | 0.00 | 0.07 | 0.02 |
| 1996.3 | 0.98 | 1.96 | 1.89 | 0.62 | 1.79 | 2.38 | 0.35 | 0.16 | 0.10 | 0.07 | 0.02 | 0.00 | 0.00 |
| 1997.3 | 2.32 | 1.70 | 0.48 | 0.17 | 0.09 | 0.14 | 0.11 | 0.04 | 0.02 | 0.01 | 0.00 | 0.00 | 0.00 |
| 1998.3 | 0.82 | 1.84 | 2.04 | 1.68 | 1.08 | 0.64 | 2.50 | 2.91 | 0.27 | 0.07 | 0.04 | 0.00 | 0.00 |
| 1999.3 | 2.68 | 1.94 | 1.00 | 1.81 | 2.00 | 1.34 | 0.35 | 0.83 | 0.69 | 0.04 | 0.02 | 0.03 | 0.00 |
| 2000.3 | 4.25 | 5.26 | 2.07 | 0.82 | 0.88 | 0.52 | 0.62 | 0.26 | 0.39 | 0.64 | 0.10 | 0.00 | 0.01 |
| 2001 | 1.78 | 14.31 | 12.75 | 3.71 | 1.23 | 0.63 | 0.52 | 0.59 | 0.13 | 0.54 | 1.21 | 0.09 | 0.06 |

Standardized Sentinel gillnet Resdiuals; MSE= 0.68

| | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|
| 1995.5 | 0.30 | 0.05 | 0.88 | -0.08 | 1.25 | 0.27 | 0.24 | 0.96 |
| 1996.5 | 0.44 | 0.82 | 0.69 | 1.51 | 0.00 | 0.76 | 0.17 | -0.54 |
| 1997.5 | 0.15 | 1.12 | 1.76 | 0.66 | 0.81 | 0.74 | 0.92 | 1.47 |
| 1998.5 | -0.17 | -0.54 | -0.99 | 0.38 | -0.09 | -0.48 | -0.16 | 0.33 |
| 1999.5 | -0.31 | -0.86 | -0.91 | -1.10 | -0.82 | -0.85 | -1.08 | -0.98 |
| 2000.5 | -0.28 | -0.72 | -1.49 | -1.41 | -1.20 | -0.52 | -0.01 | -0.79 |

Unstandardized Sentinel gillnet Resdiuals; MSE= 1.07

| | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|
| 1995.5 | 0.01 | 0.00 | 1.23 | -0.35 | 1.88 | 0.29 | 0.04 | 0.06 |
| 1996.5 | 0.01 | 0.09 | 0.58 | 4.25 | 0.00 | 0.68 | 0.06 | -0.06 |
| 1997.5 | 0.00 | 0.11 | 2.15 | 1.08 | 2.07 | 1.74 | 0.28 | 0.29 |
| 1998.5 | -0.00 | -0.05 | -0.91 | 0.82 | -0.12 | -0.62 | -0.11 | 0.05 |
| 1999.5 | -0.01 | -0.08 | -0.75 | -1.62 | -1.27 | -0.54 | -0.39 | -0.30 |
| 2000.5 | -0.01 | -0.07 | -1.25 | -1.91 | -1.10 | -0.30 | -0.00 | -0.13 |

Table 21. Cont'd.

```
Sentinel gillnet                   Index

           3      4      5      6      7      8      9     10

1995.5  0.02   0.08   3.77   7.93   4.63   2.23   0.29   0.10
1996.5  0.02   0.22   2.07   9.51   7.85   2.25   0.65   0.05
1997.5  0.01   0.20   4.36   4.05   6.81   6.09   0.75   0.55
1998.5  0.00   0.03   0.71   4.84   2.35   1.72   1.08   0.25
1999.5  0.00   0.01   0.69   1.06   1.56   0.54   0.18   0.17
2000.5  0.01   0.02   0.22   0.54   0.52   0.70   0.23   0.08

Standardized Sentinel linetrawl                   Resdiuals; MSE=   0.84

           3      4      5      6      7      8      9     10

1995.5 -0.27  -0.63   1.11   1.06   1.58   0.70   0.32   1.83
1996.5  0.23  -0.30   0.44   0.66   0.94   0.88   0.67   1.19
1997.5 -0.38   0.02  -1.41  -0.97  -1.24  -0.82  -1.23  -0.18
1998.5  0.79  -0.30  -0.59  -1.45  -1.34  -1.03   0.11   0.67
1999.5  0.87  -0.35  -0.03  -0.32  -1.37  -0.30  -0.57  -1.10
2000.5 -0.91   1.55   0.49   0.87   1.57   0.98   0.96  -0.63

Unstandardized Sentinel linetrawl                   Resdiuals; MSE=   0.00
```

Table 22. Inputs for the projection of population size from 1 April 2001 to 1 April 2003.

| TAC | Period | Prop TAC |
|---|---|---|
| | 2001.3 | 0.83 |
| | 2002 | 0.17 |
| | 2002.3 | 0.83 |
| | 2003 | 0.17 |

**PR**

Ave *F* at age computed for 1998-2000 and PR computed, rescaled to a max of 1.00

| **M** | | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Assumed | 2001.3 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 |
| | 2002 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 |
| | 2002.3 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 |
| | 2003 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 |

| **Pop wt at age** | | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ave 1998-2000 | 2001.3 | 0 | 0.54466 | 0.780201 | 1.190199 | 1.780175 | 2.307148 | 2.68986 | 3.362091 | 4.222455 | 4.824078 | 5.116883 | 5.950545 | 7.60818 |
| | 2002 | 0 | 0.54466 | 0.780201 | 1.190199 | 1.780175 | 2.307148 | 2.68986 | 3.362091 | 4.222455 | 4.824078 | 5.116883 | 5.950545 | 7.60818 |
| | 2002.3 | 0 | 0.54466 | 0.780201 | 1.190199 | 1.780175 | 2.307148 | 2.68986 | 3.362091 | 4.222455 | 4.824078 | 5.116883 | 5.950545 | 7.60818 |
| | 2003 | 0 | 0.54466 | 0.780201 | 1.190199 | 1.780175 | 2.307148 | 2.68986 | 3.362091 | 4.222455 | 4.824078 | 5.116883 | 5.950545 | 7.60818 |
| | 2003.3 | 0 | 0.54466 | 0.780201 | 1.190199 | 1.780175 | 2.307148 | 2.68986 | 3.362091 | 4.222455 | 4.824078 | 5.116883 | 5.950545 | 7.60818 |

| **Catch wt at age** | | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ave 1998-2000 | 2001.3 | 0 | 0.645134 | 0.945398 | 1.499341 | 2.142105 | 2.563593 | 2.911021 | 3.703892 | 4.682419 | 5.382633 | 5.534487 | 6.317831 | 8.231387 |
| | 2002 | 0 | 0.645134 | 0.945398 | 1.499341 | 2.142105 | 2.563593 | 2.911021 | 3.703892 | 4.682419 | 5.382633 | 5.534487 | 6.317831 | 8.231387 |
| | 2002.3 | 0 | 0.645134 | 0.945398 | 1.499341 | 2.142105 | 2.563593 | 2.911021 | 3.703892 | 4.682419 | 5.382633 | 5.534487 | 6.317831 | 8.231387 |
| | 2003 | 0 | 0.645134 | 0.945398 | 1.499341 | 2.142105 | 2.563593 | 2.911021 | 3.703892 | 4.682419 | 5.382633 | 5.534487 | 6.317831 | 8.231387 |

| **Maturity at age** | | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| As projected | 2001.3 | 0.004837 | 0.0221 | 0.096667 | 0.31131 | 0.6054 | 0.94464 | 0.99312 | 0.99989 | 1 | 0.99997 | 1 | 1 | 1 |
| from model fit | 2002 | 0.004837 | 0.0221 | 0.096667 | 0.33984 | 0.74593 | 0.86176 | 0.98773 | 0.99687 | 0.99999 | 1 | 1 | 1 | 1 |
| | 2002.3 | 0.004837 | 0.0221 | 0.096667 | 0.33984 | 0.74593 | 0.86176 | 0.98773 | 0.99687 | 0.99999 | 1 | 1 | 1 | 1 |
| | 2003 | 0.004837 | 0.0221 | 0.096667 | 0.33984 | 0.7116 | 0.95017 | 0.96202 | 0.99737 | 0.99982 | 1 | 1 | 1 | 1 |
| | 2003.3 | 0.004837 | 0.0221 | 0.096667 | 0.33984 | 0.7116 | 0.95017 | 0.96202 | 0.99737 | 0.99982 | 1 | 1 | 1 | 1 |

Table 23. Results of the evaluation of risk associated with alternative TAC options for 2002/2003.

Prob of SSB declining

| TAC kt | A | B | C | D | E |
|---|---|---|---|---|---|
| 10 | <5 | <5 | <5 | <5 | 10 |
| 15 | <5 | <5 | <5 | <5 | 15 |
| 20 | <5 | <5 | <5 | <5 | 19 |

Prob of F>F0.1

| TAC | A | B | C | D | E |
|---|---|---|---|---|---|
| 10 | <5 | <5 | <5 | 19 | 12 |
| 15 | <5 | <5 | 25 | 88 | 65 |
| 20 | 27 | <5 | 95 | 100 | 98 |

Prob of F>one half F0.1

| TAC | A | B | C | D | E |
|---|---|---|---|---|---|
| 10 | 28 | 1 | 95 | 100 | 96 |
| 15 | 87 | 26 | 95 | 100 | 100 |
| 20 | 99 | 69 | 95 | 100 | 100 |

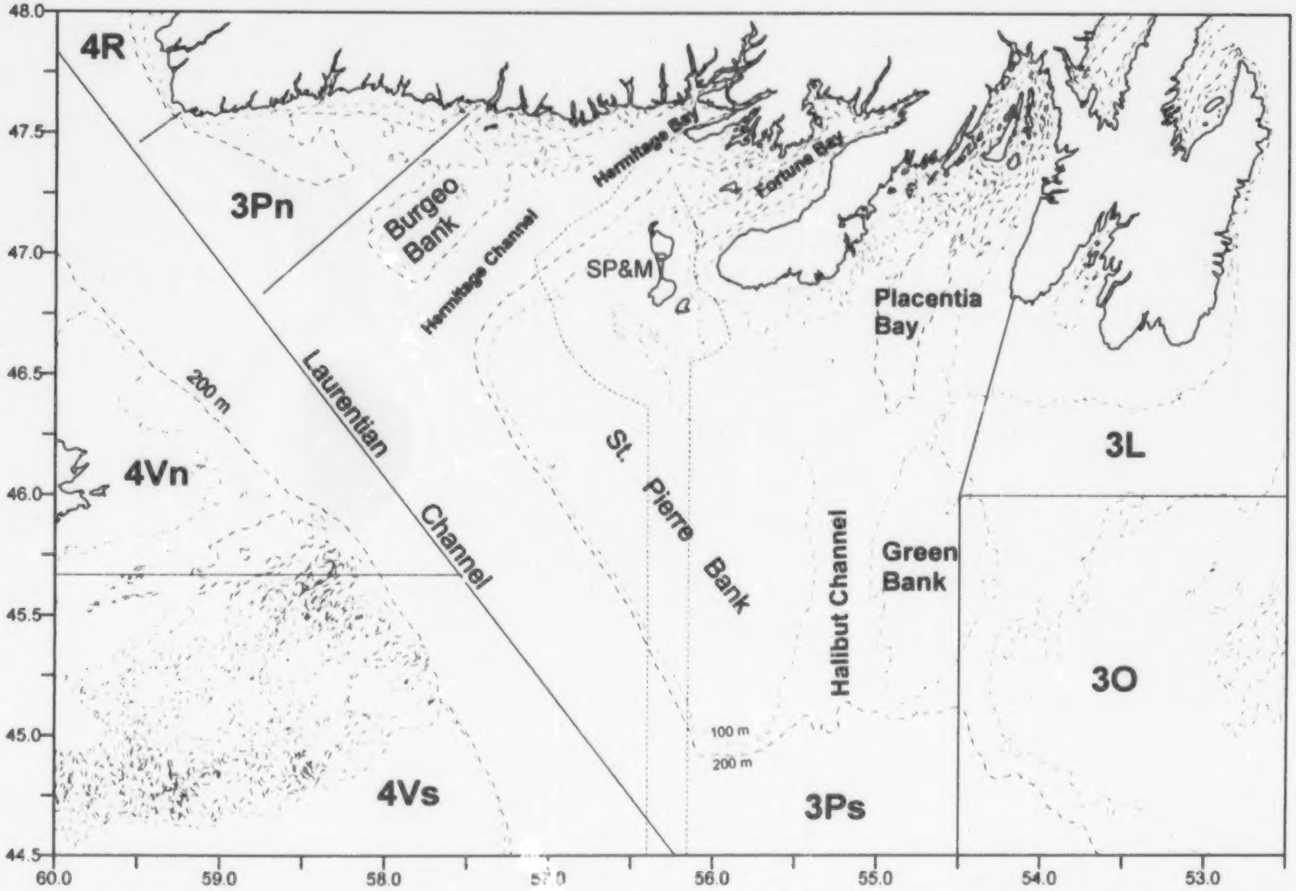

4R
3Pn
Burgeo Bank
Hermitage Channel
Hermitage Bay
Fortune Bay
SP&M
Placentia Bay
Laurentian Channel
200 m
4Vn
St. Pierre Bank
Halibut Channel
Green Bank
3L
3O
100 m
200 m
4Vs
3Ps
48.0
47.5
47.0
46.5
46.0
45.5
45.0
44.5
60.0
59.0
58.0
57.0
56.0
55.0
54.0
53.0

Fig. 1. NAFO Subdivision 3Ps management unit, boundaries of French economic zone (fine dashed line) and main fishing areas.

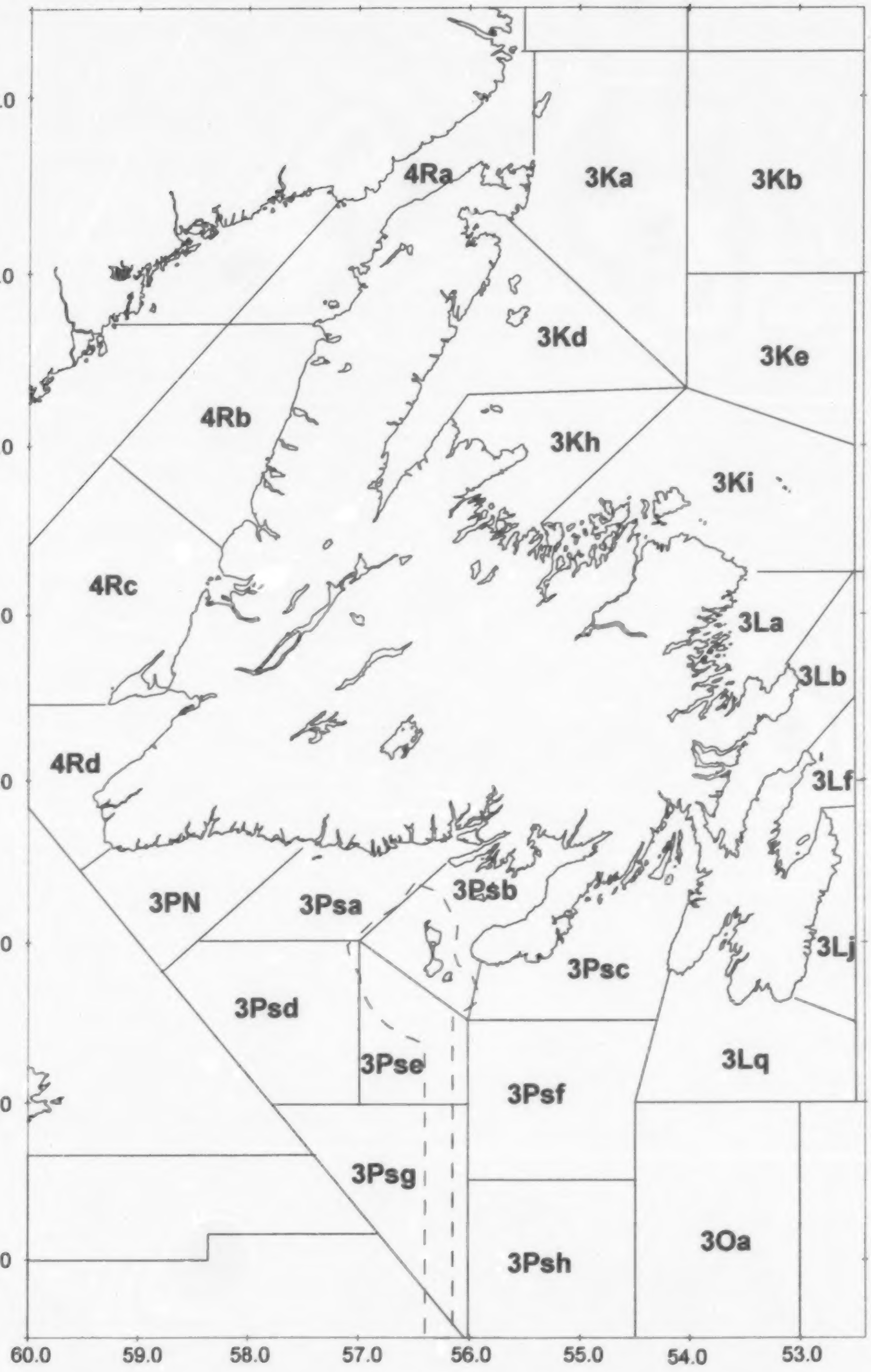

52.0
51.0
50.0
49.0
48.0
47.0
46.0
45.0
60.0
59.0
58.0
57.0
56.0
55.0
54.0
53.0
4Ra
3Ka
3Kb
3Kd
3Ke
4Rb
3Kh
3Ki
4Rc
3La
3Lb
4Rd
3Lf
3PN
3Psa
3Psb
3Lj
3Psc
3Psd
3Pse
3Lq
3Psf
3Psg
3Psh
3Oa

Fig. 2. Names and boundaries of NAFO statistical areas around insular Newfoundland. The dashed line indicates the boundary of the French economic zone.

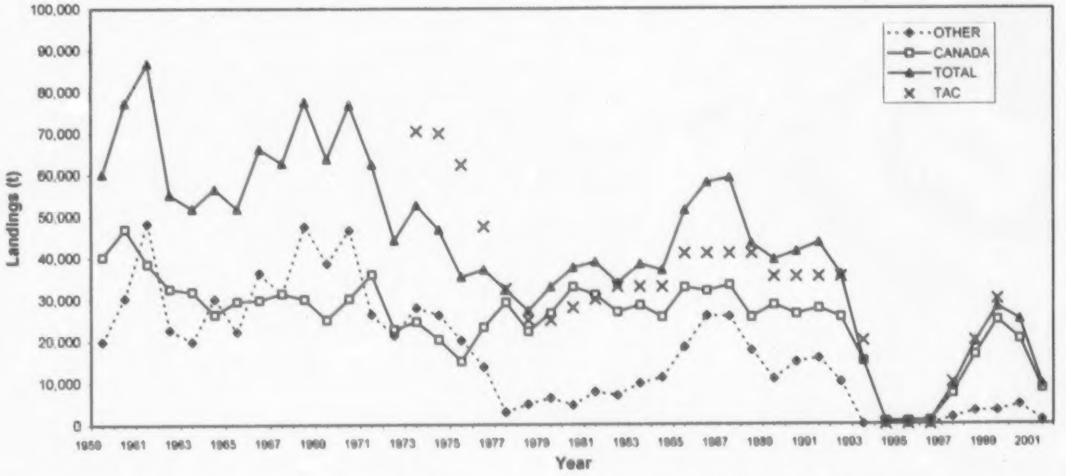


Fig. 3a. Reported landings of cod by Canadian and non-Canadian vessels in NAFO Subdiv. 3Ps during 1959 to 1 Oct 2001.

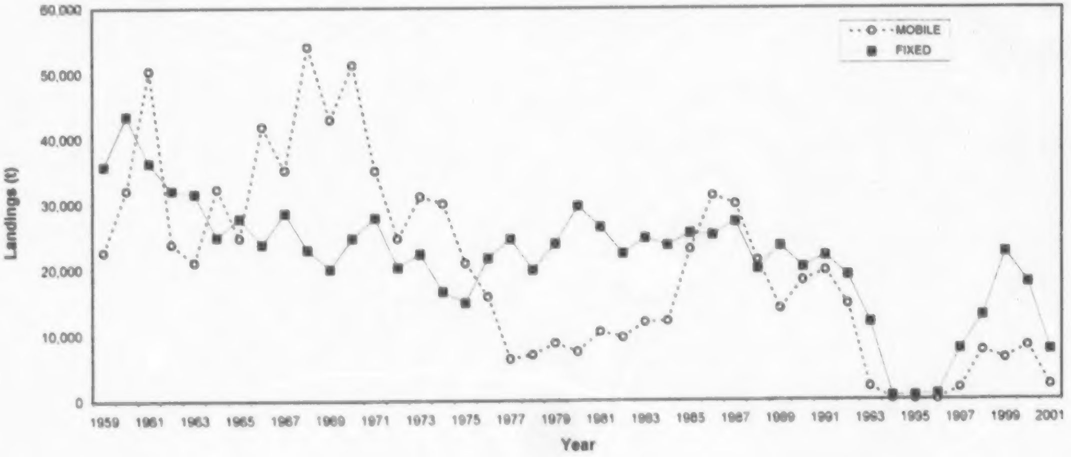


Fig 3b Reported landings of cod by fixed and mobile gear in NAFO Subdiv 3Ps during 1959 to 1 Oct 2001

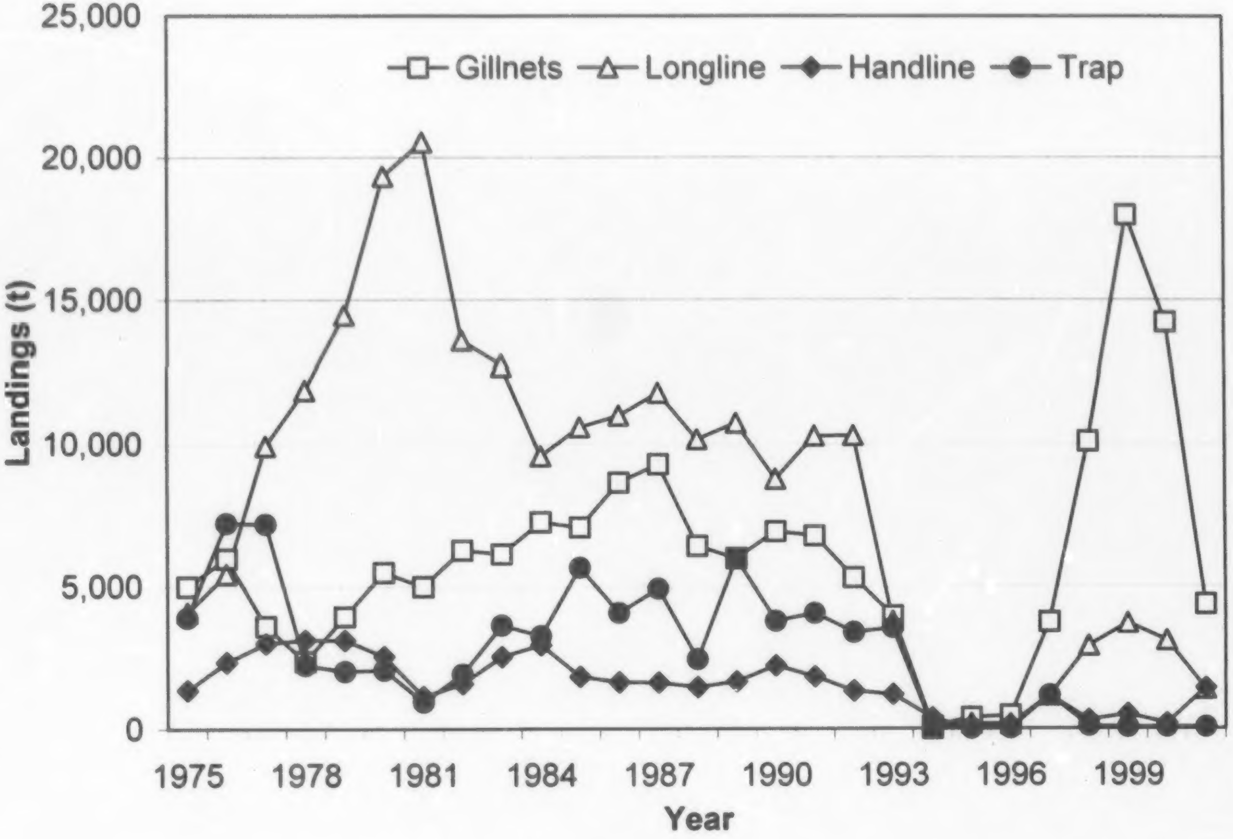
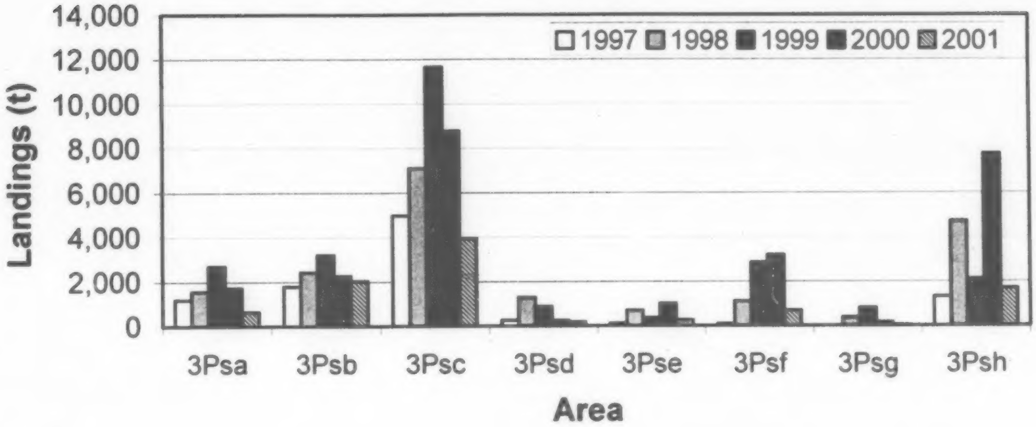


Fig. 4. Reported landings of cod by various fixed gears in NAFO Subdiv. 3Ps during 1975 - Oct 2001



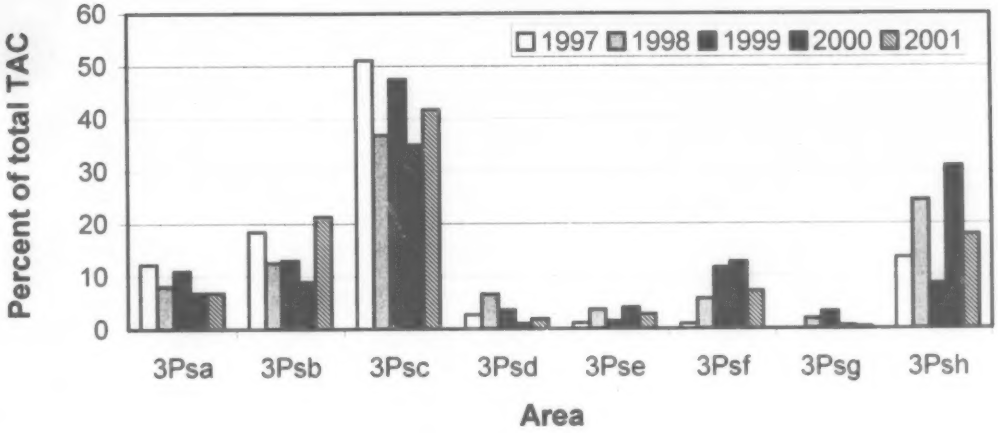


Fig. 5. Annual reported landings of cod by unit area from NAFO Subdiv. 3Ps during 1997-2001(landings for 2001 are to 1 October as the fishery was still in progress).

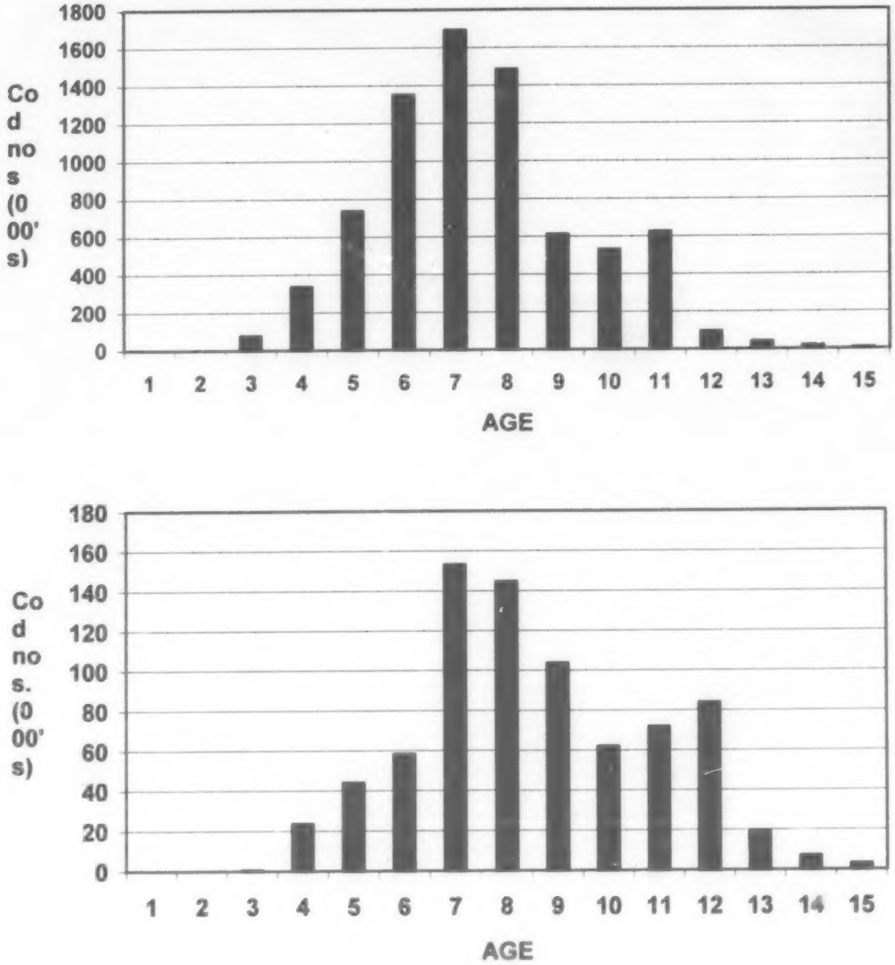


Fig. 6. Catch numbers-at-age for the commercial fishery in NAFO Sudiv. 3Ps during 2000 (upper panel) and during January-March 2001 (lower panel).

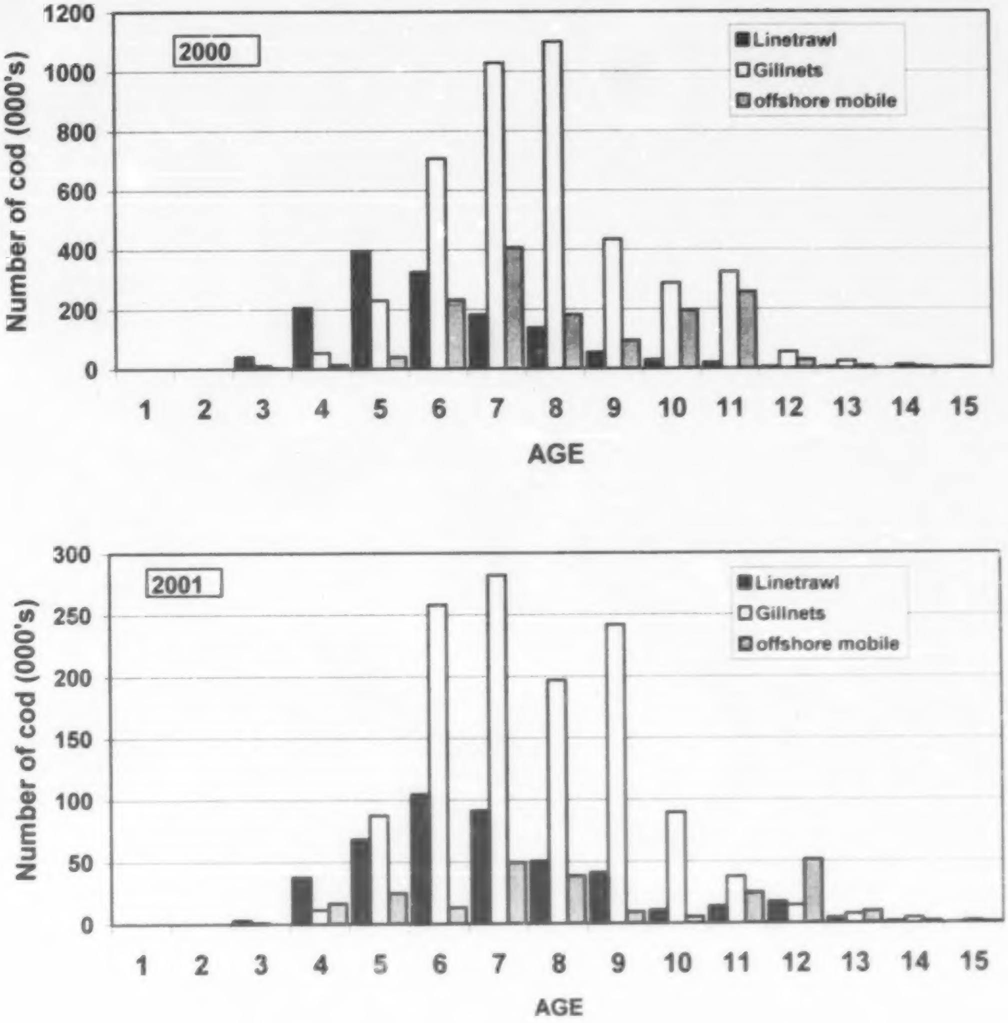


Fig. 7. Catch-at-age (numbers) for main gear types used in the cod fishery in NAFO Subdiv. 3Ps during 2000 and 2001 (to 31 March).

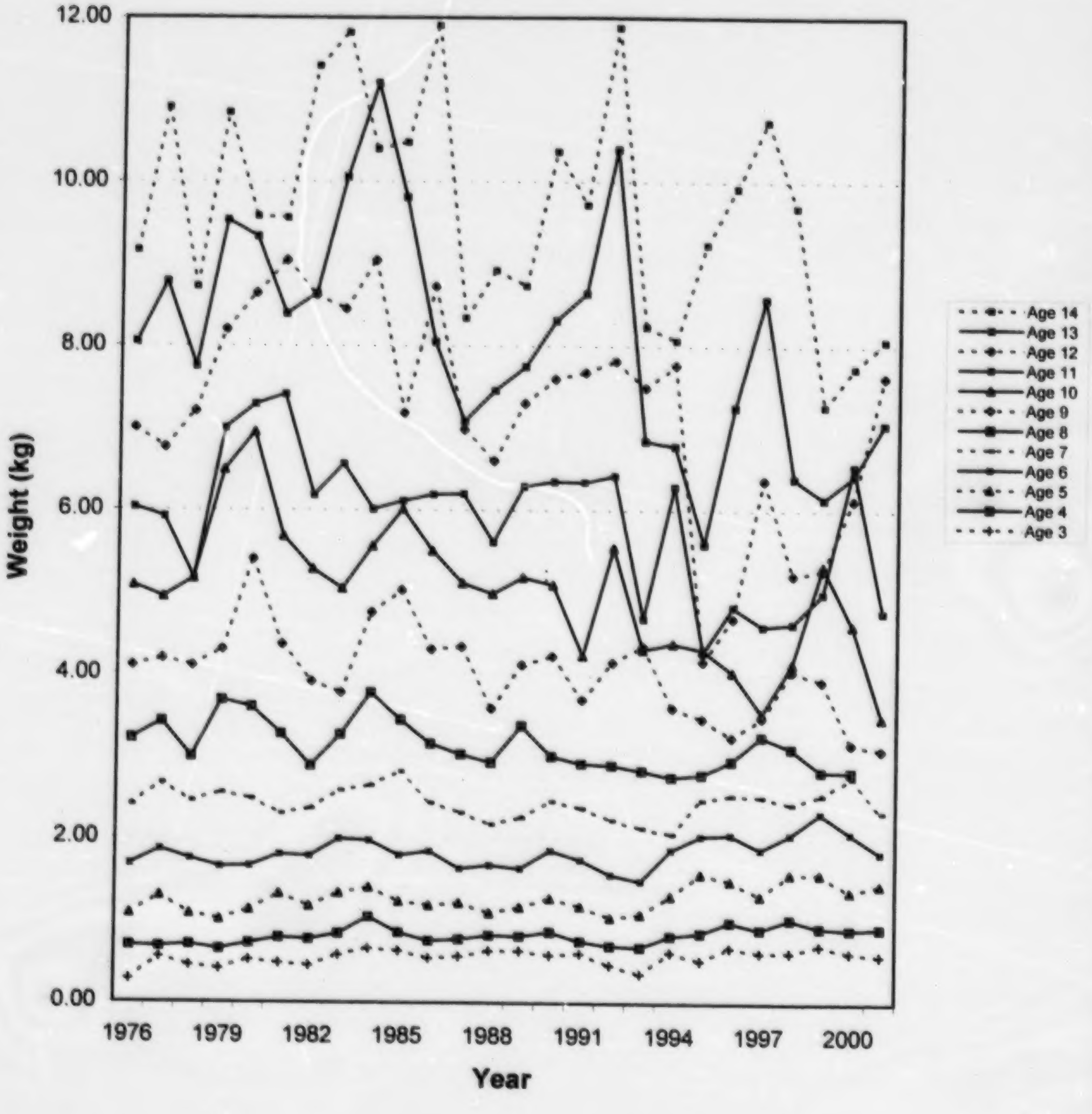


Fig. 8a. Mean weights-at-age (3-14) from the commercial catch in 3Ps during 1976-2001 (2001 values are based on January-March data only).

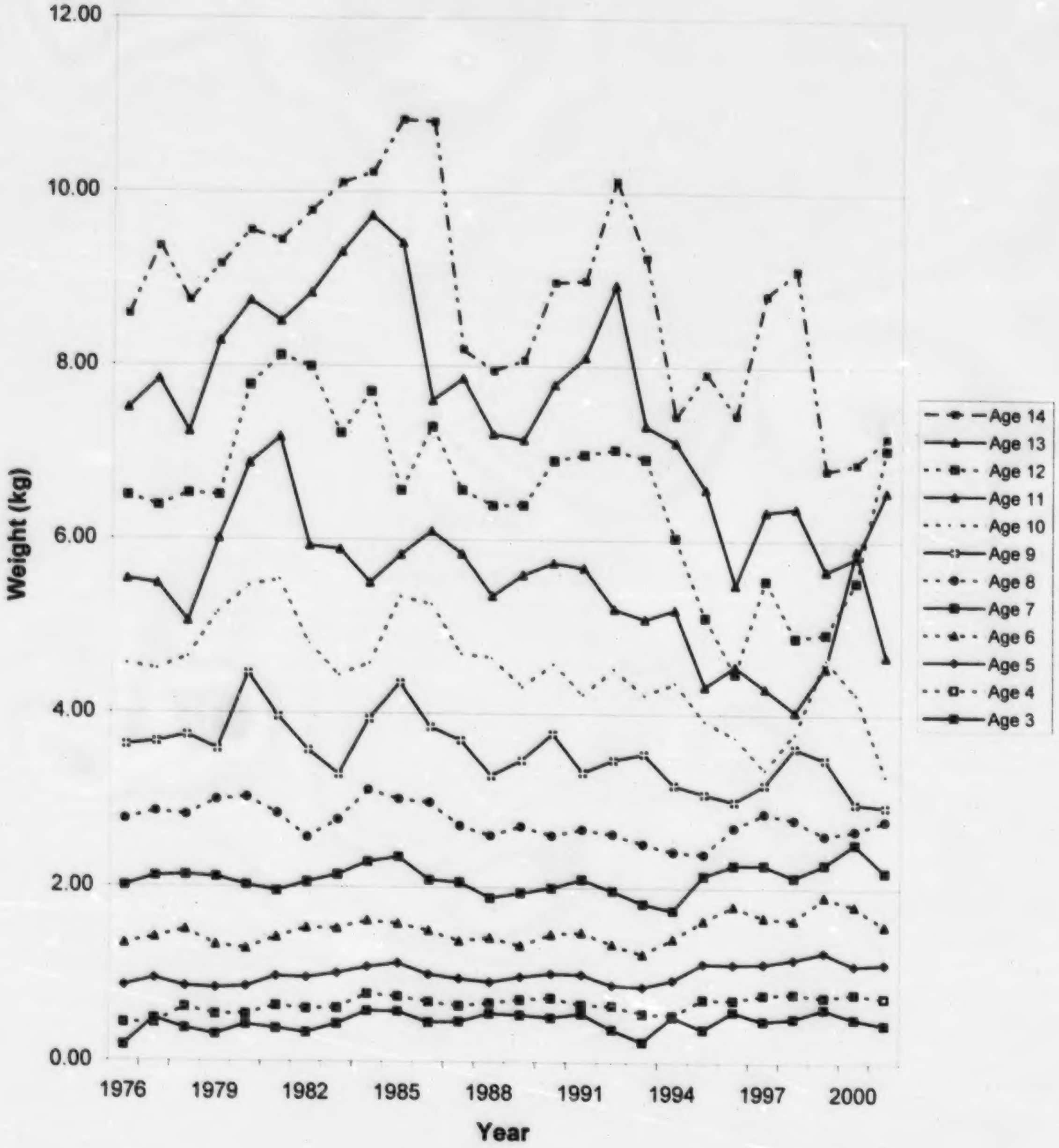
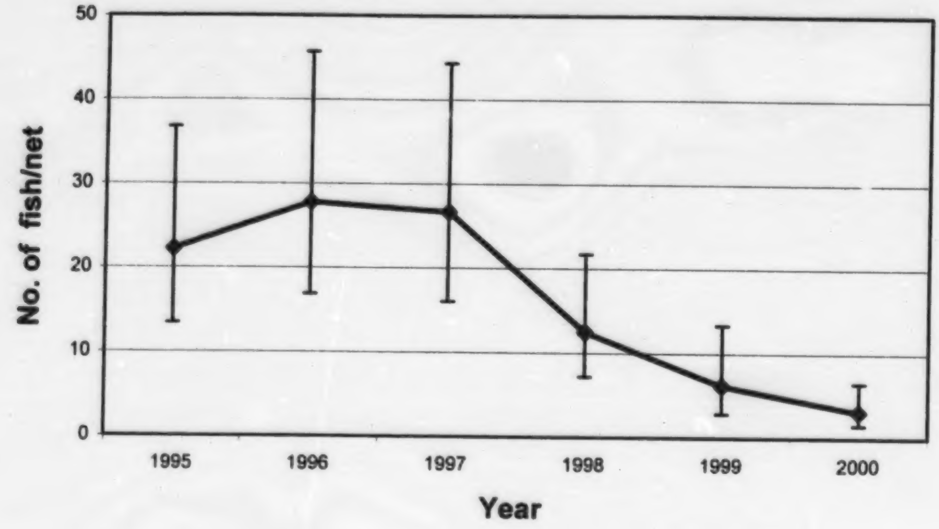


Fig. 8b. Beginning of year mean weights-at-age from the commercial catch in 3Ps during 1976-2001 (2001 values are based on January-March data only).



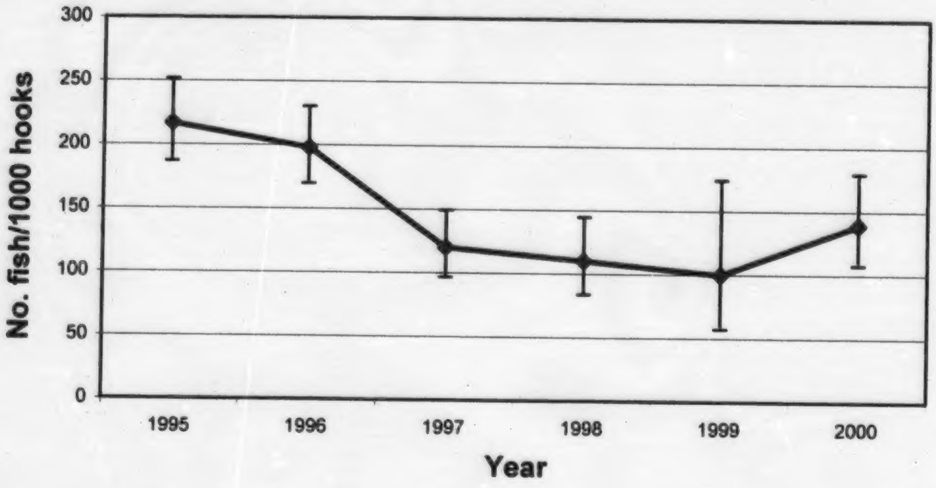


Fig. 9. Standardized total annual catch rate indices for gill nets (5.5 in mesh) and line-trawls (with 95% CL's.) estimated using data from sentinel fishery fixed sites. Catch rates are fish per net for gillnet and fish per 1000 hooks for line-trawl.

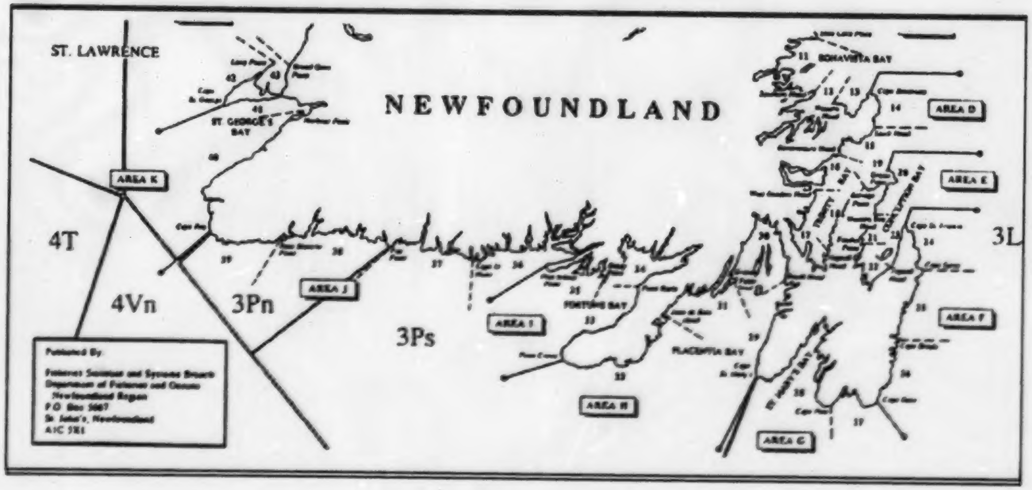

ST. LAWRENCE
NEWFOUNDLAND
ST. GEORGE'S BAY
BONAVISTA BAY
FORTUNE BAY
PLACENTIA BAY
AREA K
AREA J
AREA I
AREA H
AREA G
AREA F
AREA E
AREA D
4T
4Vn
3Pn
3Ps
3L
Published By

Fig. 10A. Southern Newfoundland showing NAFO Subdivision 3Ps, boundaries of management areas H, I, J (solid lines with terminal dot), and boundaries of lobster management areas numbered 29-37 (dashed lines).

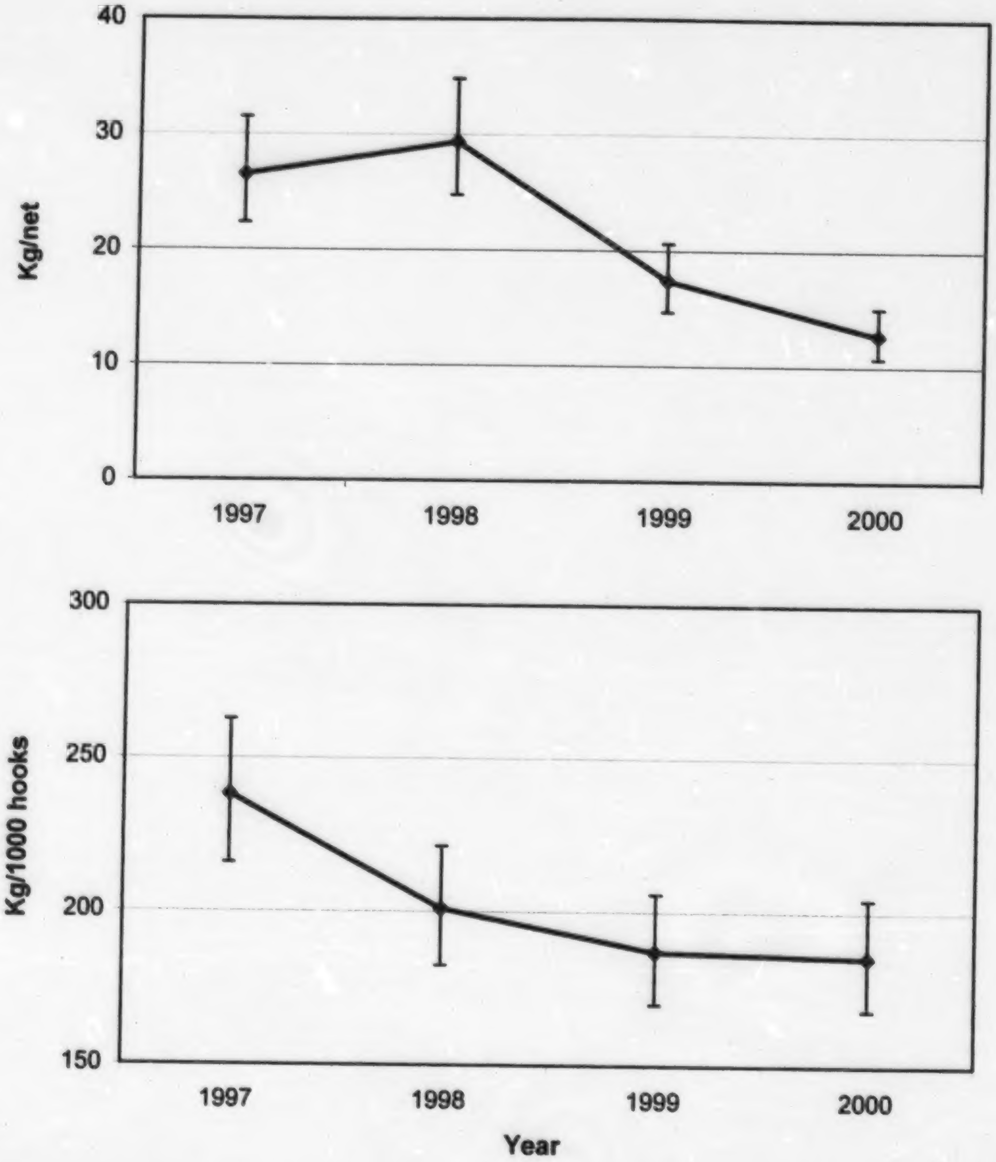


Fig. 10b. Standardized total annual catch rate indices (with 95% CL's.) for gillnets and line-trawls estimated using data from science logbooks for the <35 ft sector. Catch rates are expressed as kg per net for gillnets and kg per 1000 hooks for line-trawl.

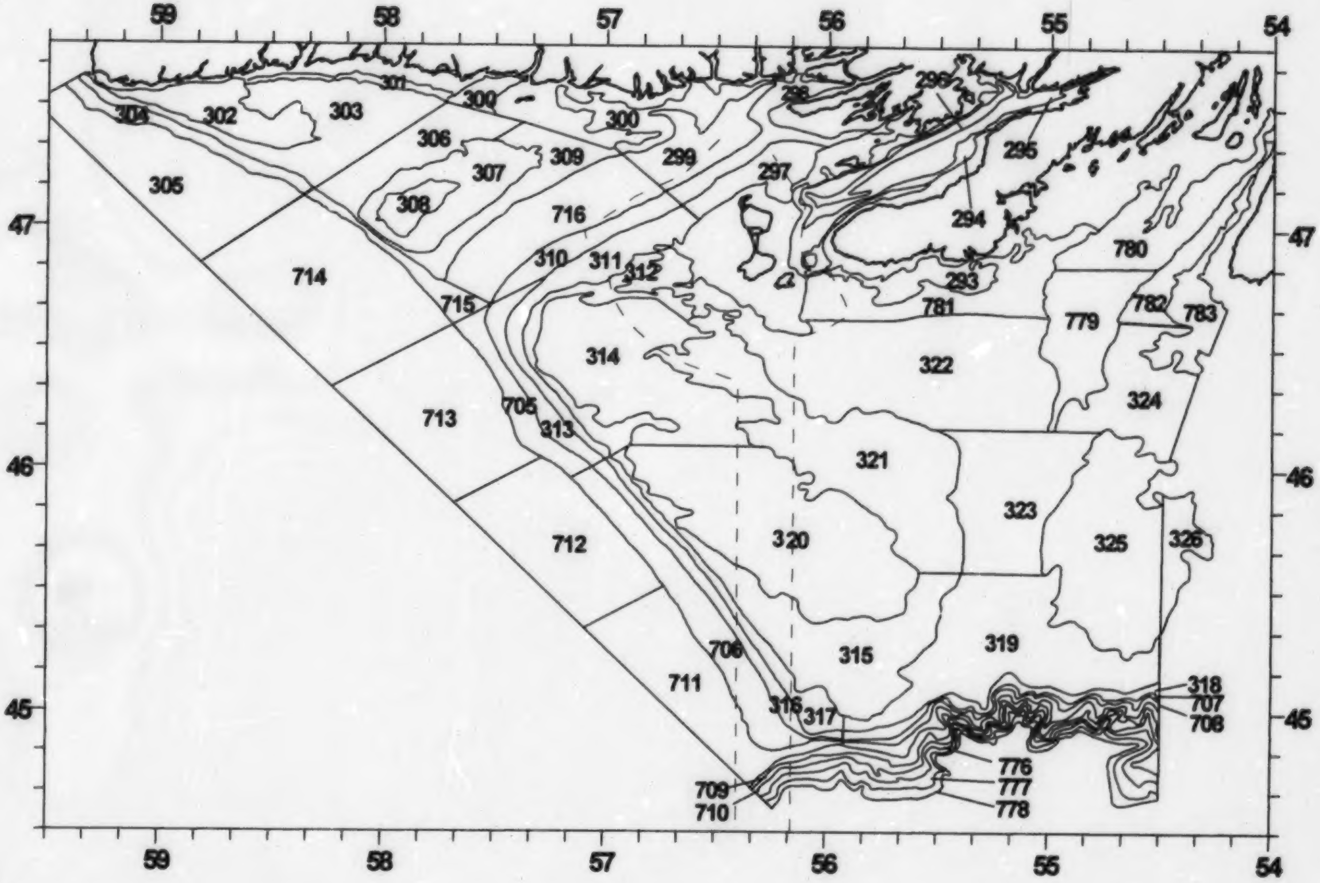
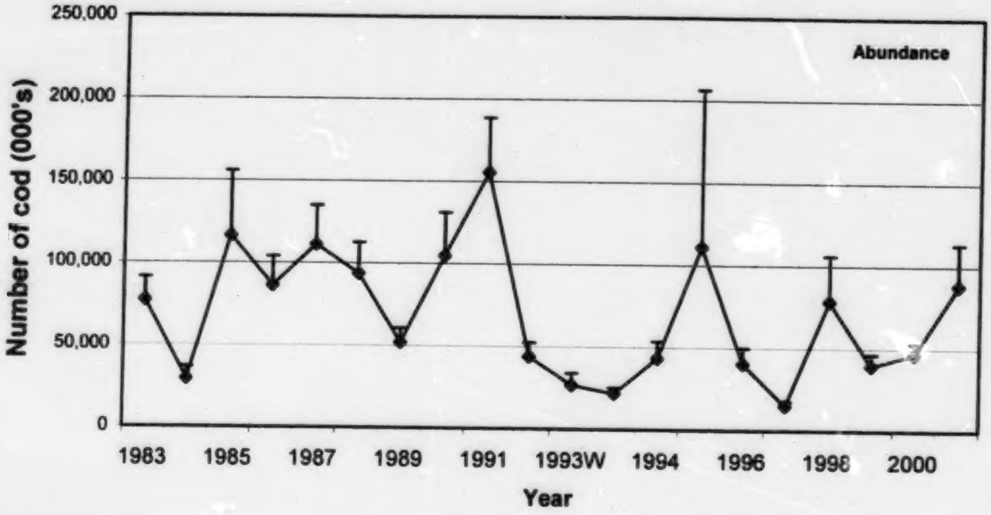

59
58
57
56
55
54
47
46
45
301
304
302
303
300
306
307
308
309
300
299
297
298
296
295
294
293
305
716
714
715
310
311
312
314
705
313
713
712
711
706
316
317
315
320
321
322
781
780
779
782
783
324
323
325
326
319
318
707
708
776
777
778
709
710

Fig. 11. Stratum area boundaries and area surveyed during the DFO research vessel bottom-trawl survey of NAFO Subdiv. 3Ps (revised March 1999).



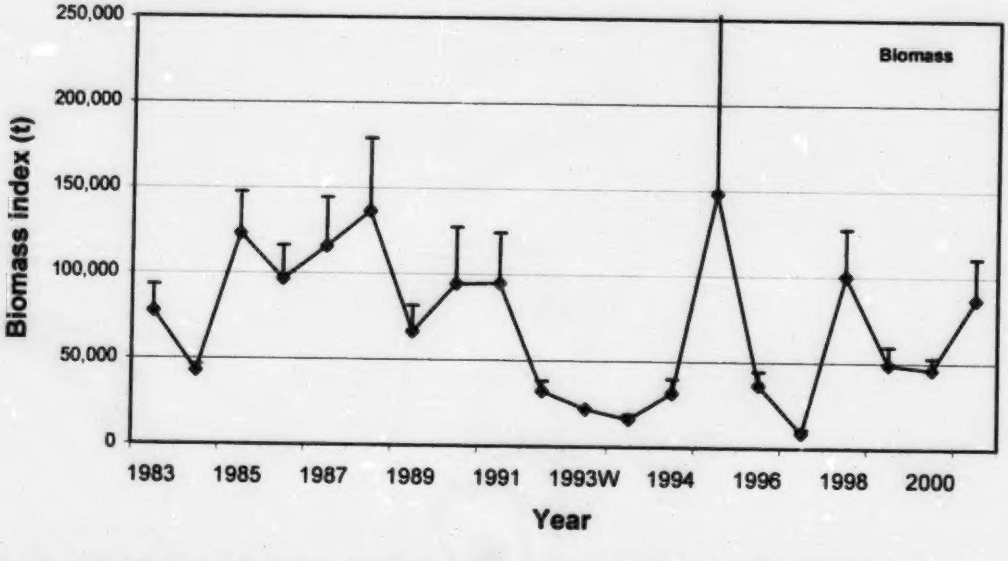


Fig. 12. Abundance and biomass indices for cod in NAFO Subdiv. 3Ps from DFO research vessel bottom trawl surveys during winter/spring from 1983-2001. There were two surveys in 1993. Error bars show plus one standard deviation.

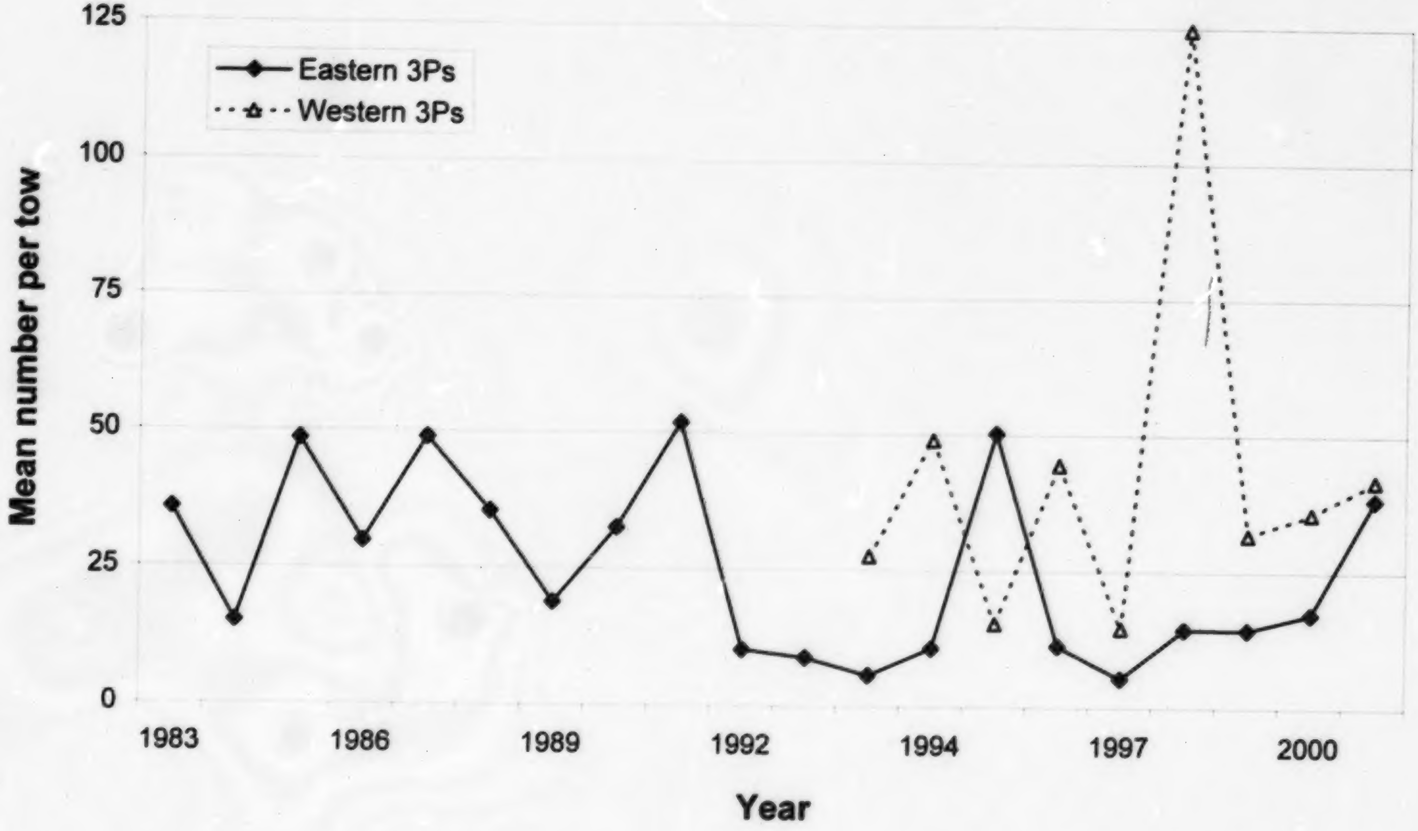


Fig. 13. Catch rate index for the eastern and western (Burgeo area) portions of 3Ps from the DFO research vessel bottom trawl surveys. There were two surveys in 1993.

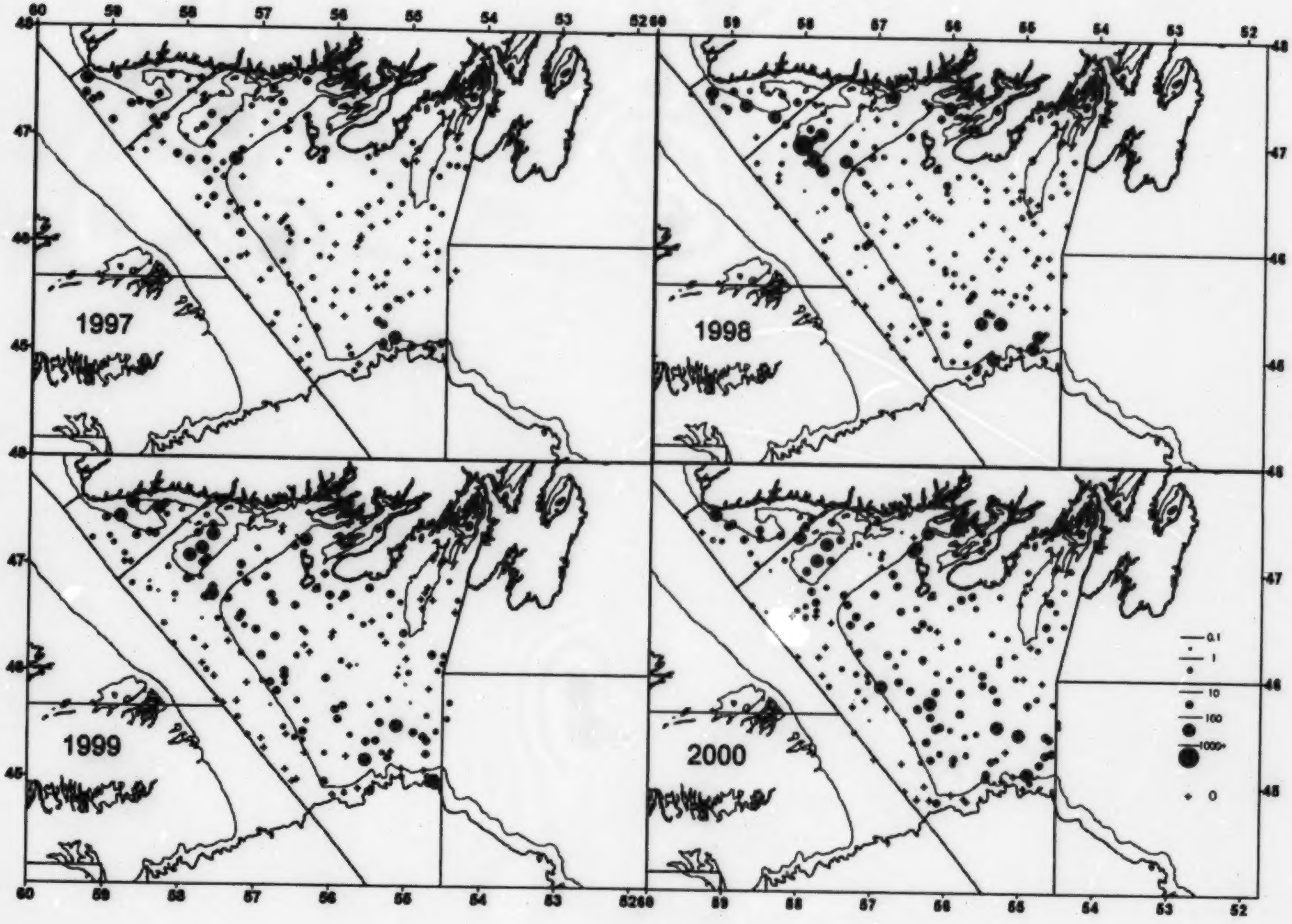

1997
1998
1999
2000
60
59
58
57
56
55
54
53
52
48
47
46
45
0.1
1
10
100
1000+
0

Fig. 14. Distribution of cod catches (number per tow) during DFO research vessel trawl surveys in NAFO Subdiv. 3Ps during April 1997-2000.

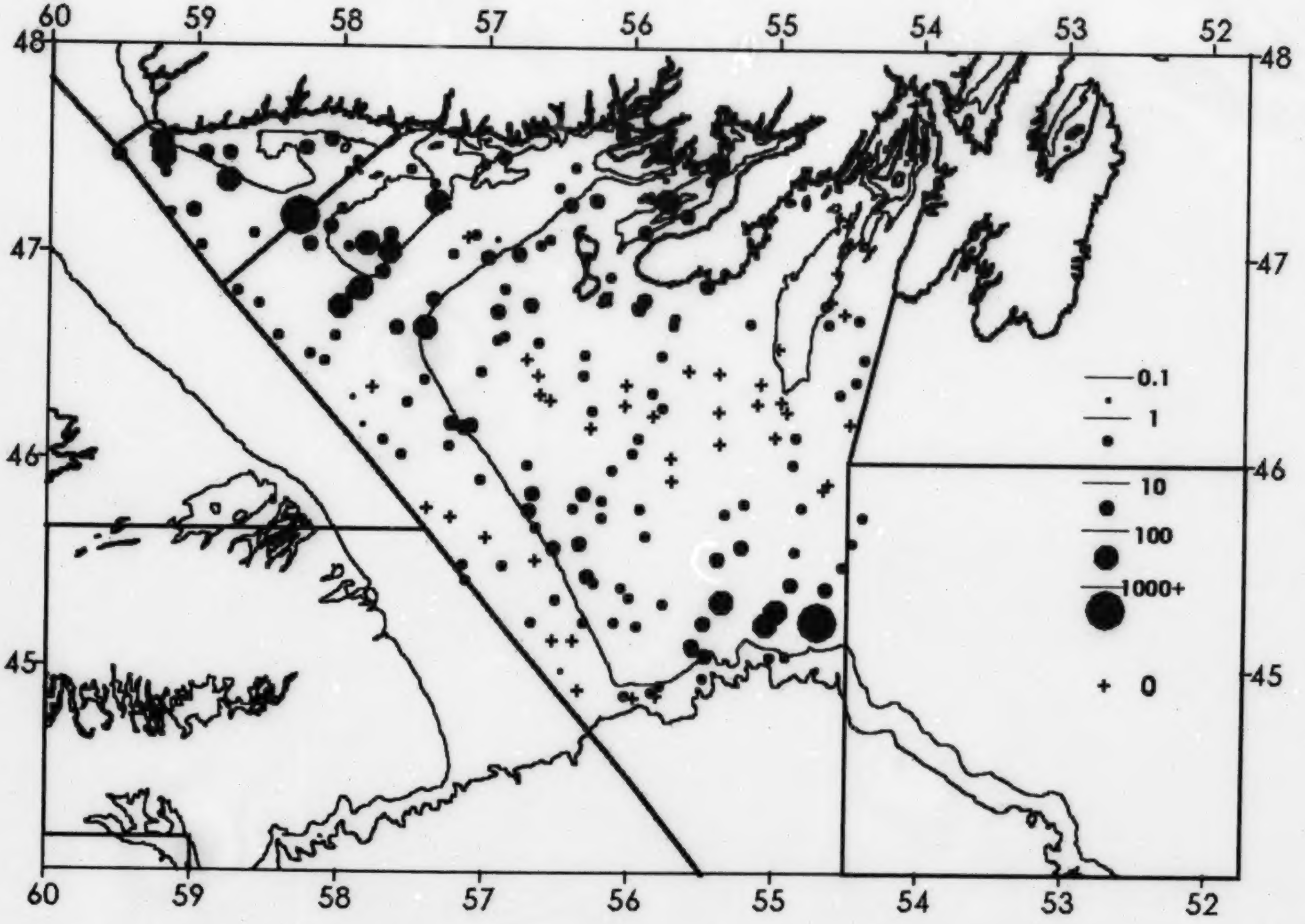

60
59
58
57
56
55
54
53
52
48
47
46
45
0.1
1
10
100
1000+
0

Fig. 15. Distribution of cod catches (number per tow) during DFO research vessel trawl surveys in NAFO Subdiv. 3Ps during April 2001.

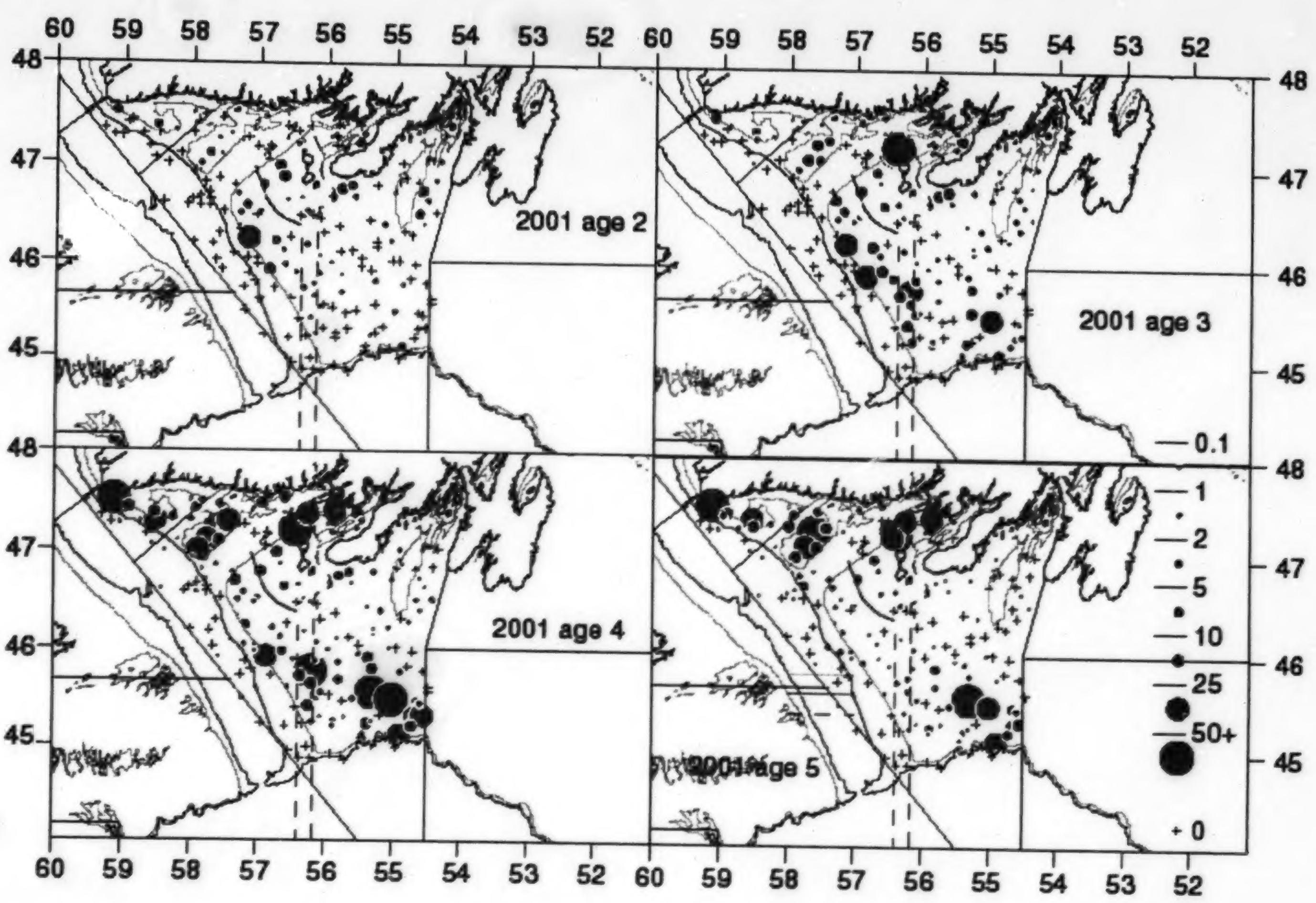

2001 age 2
2001 age 3
2001 age 4
2001 age 5
0.1
1
2
5
10
25
50+
+ 0
60
59
58
57
56
55
54
53
52
48
47
46
45

Fig. 16. Distribution of cod catches (number per tow) by age (2-5) from Canadian research vessel trawl surveys in NAFO Subdiv. 3Ps during April 2001

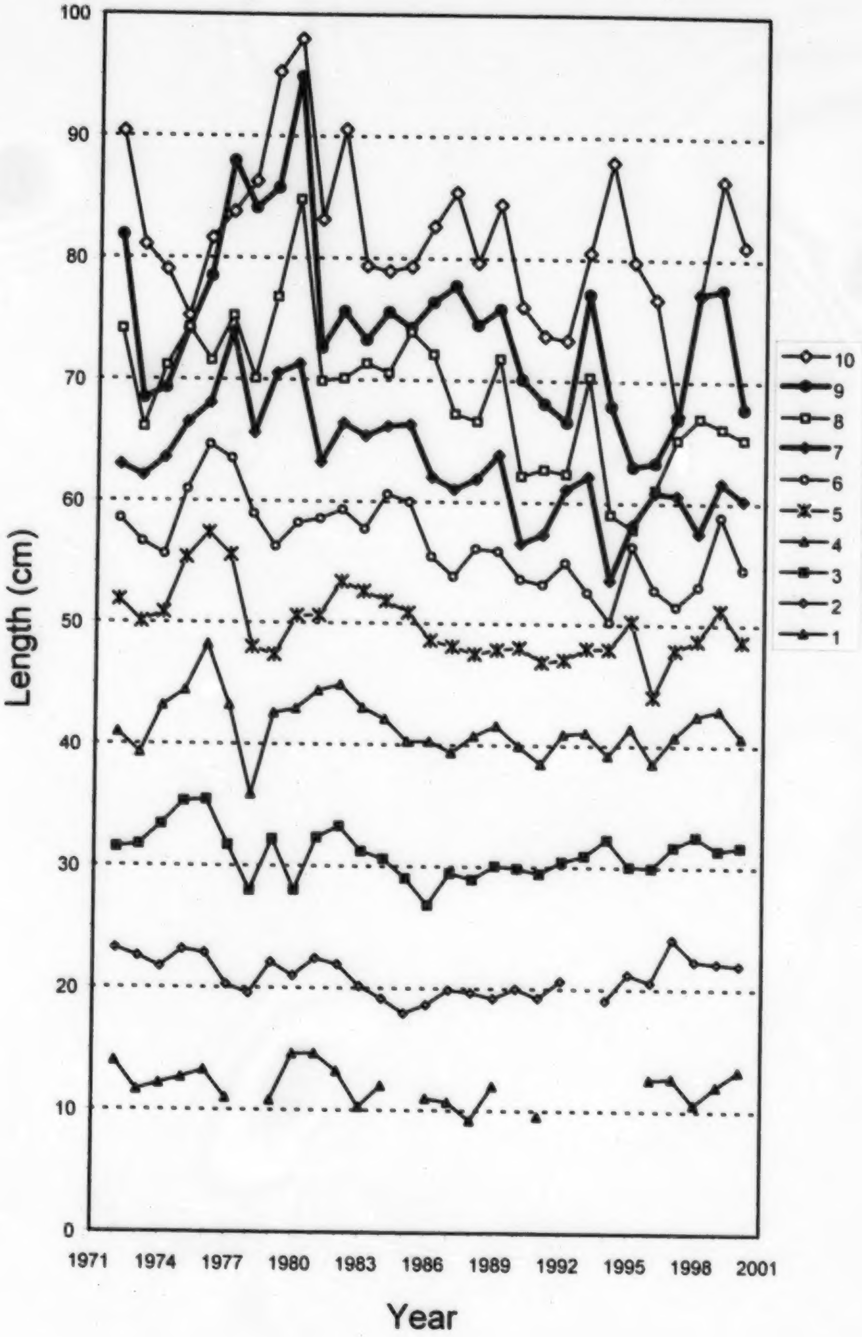


Fig. 17. Mean length at ages 1-10 of cod in Subdivision 3Ps in 1972-2001, as determined from sampling during DFO bottom-trawl surveys in winter-spring.

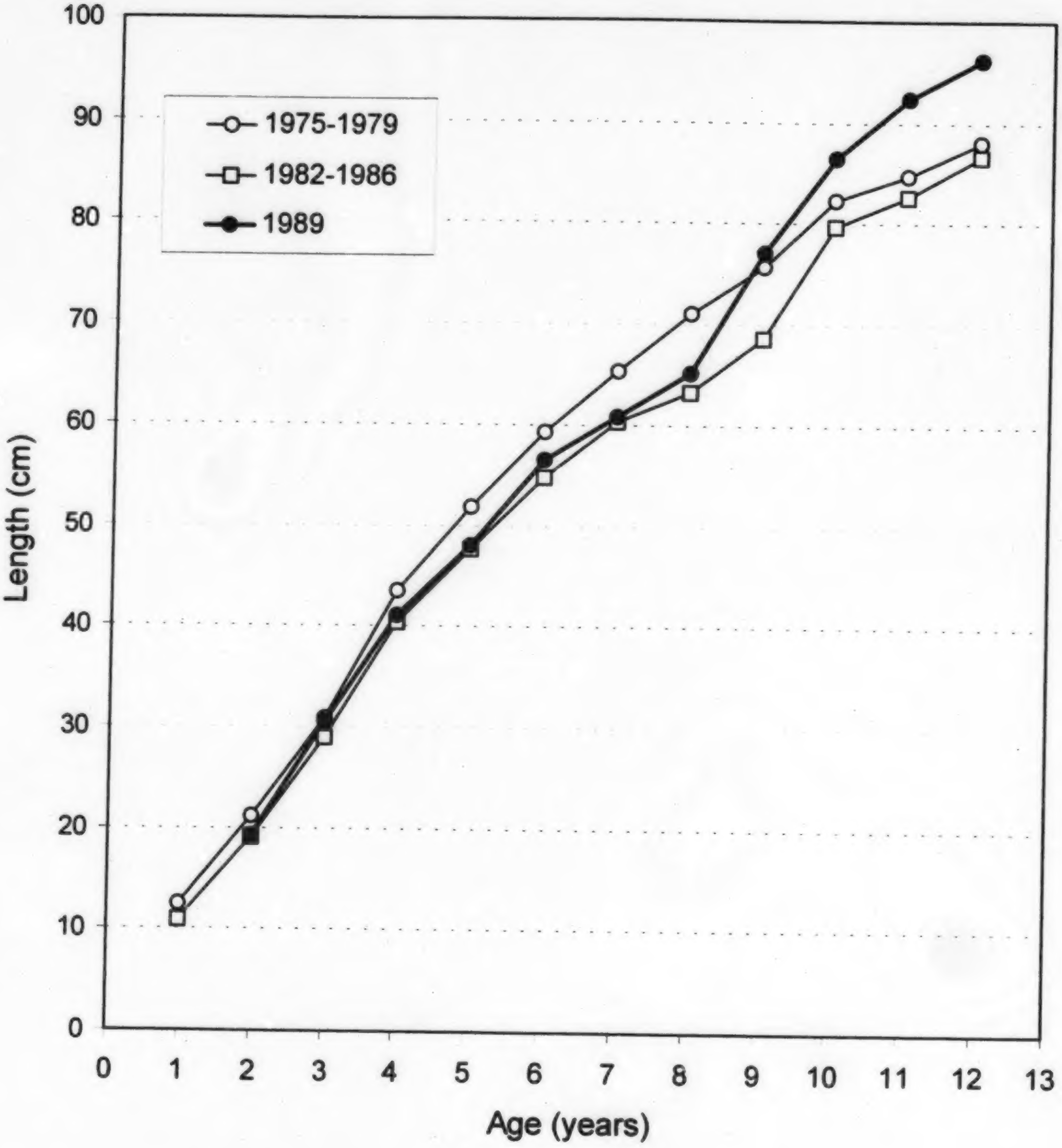


Fig. 18 . Length-at-age of the 1989 year-class, as determined from sampling during winter-spring surveys in Subdivision 3Ps. Mean lengths-at-age of the 1975-1979 and the 1982-1986 year-classes are shown for comparison.

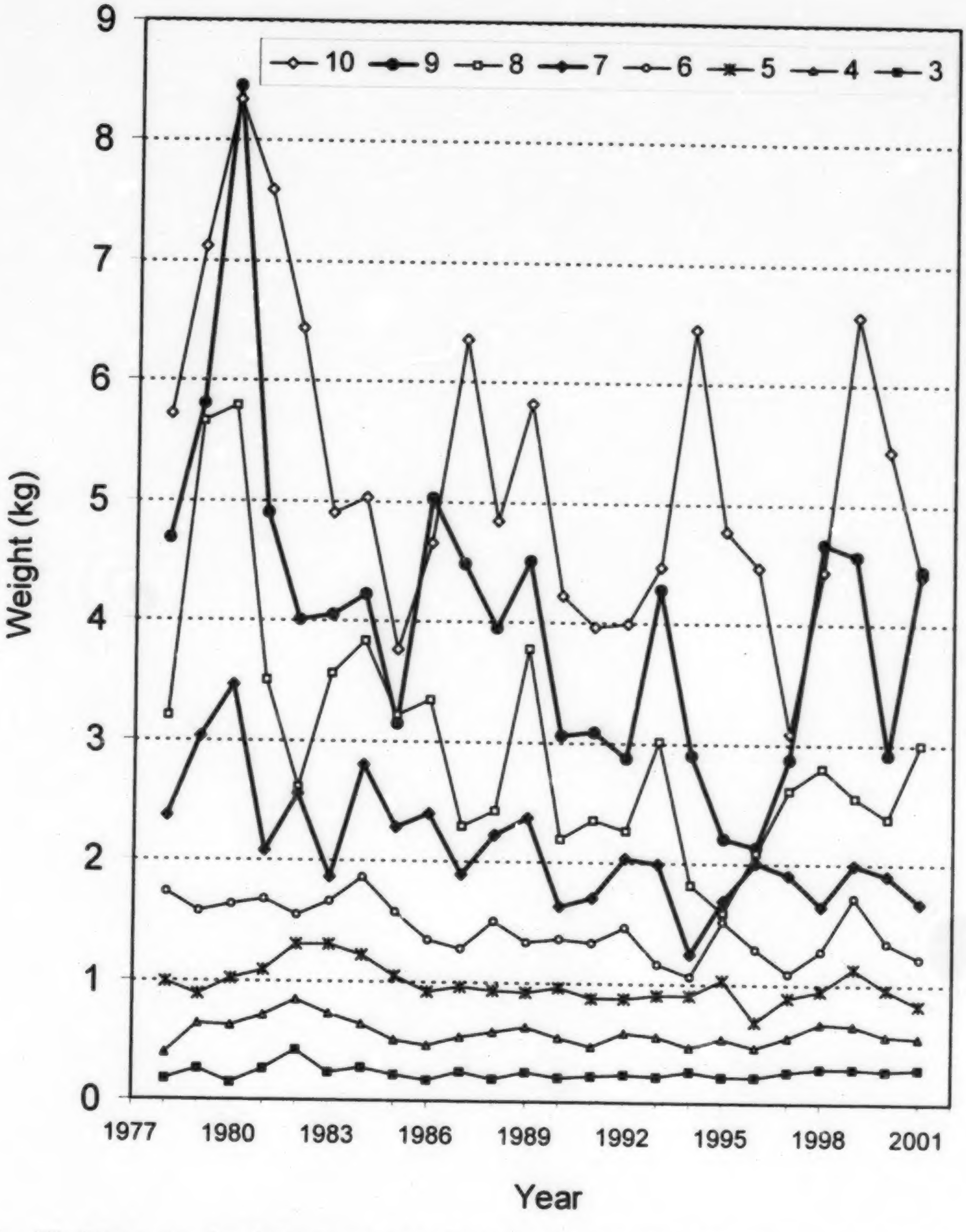


Fig. 19. Mean round weight-at-age (kg) of cod sampled during DFO bottom-trawl surveys in Subdivision 3Ps in winter-spring 1978-2001.

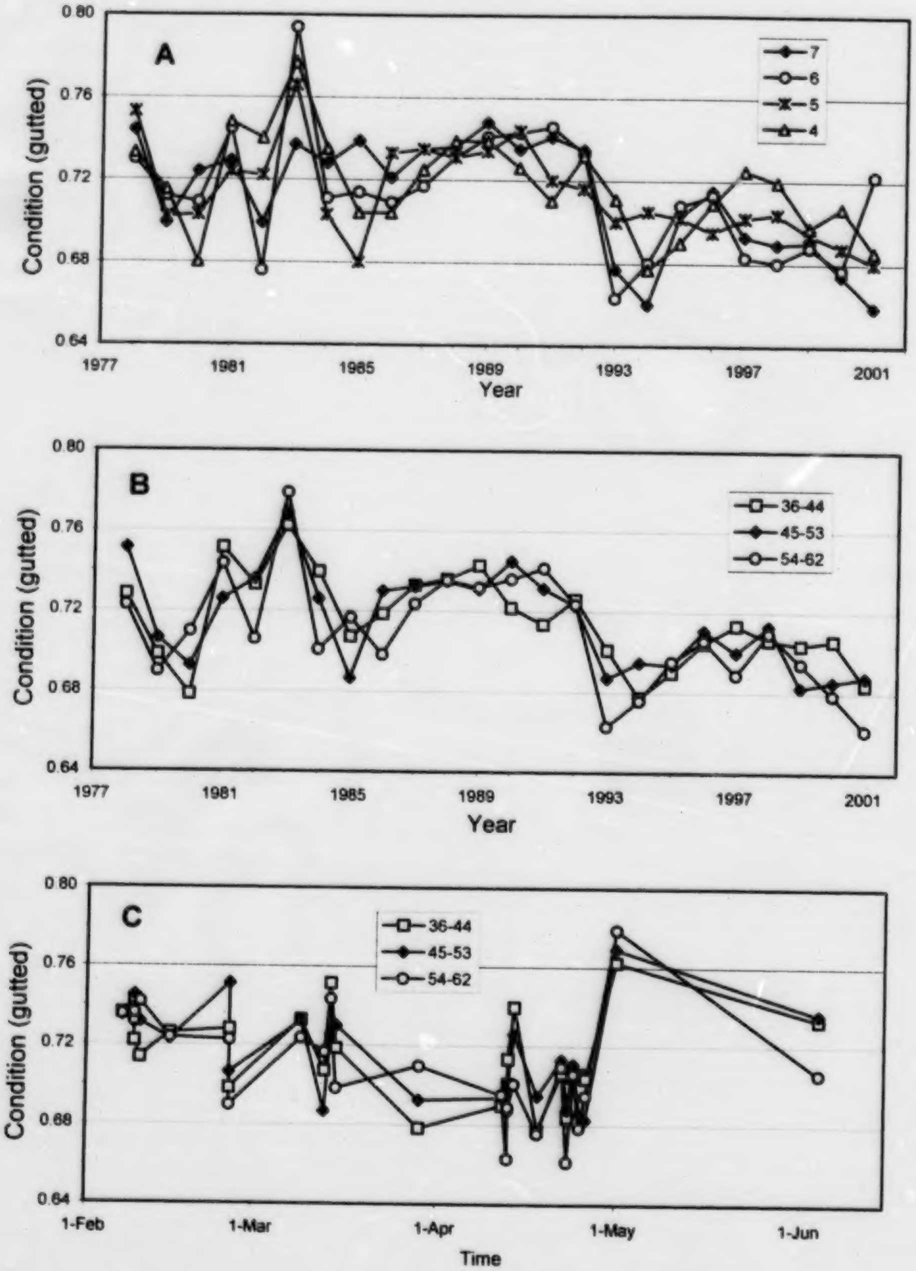


Fig. 20. Mean gutted condition of cod sampled during DFO bottom-trawl surveys in Subdivision 3Ps in 1978-2001; (A) by age and year, (B) by length-group and year, and (C) by length-group and median date of collection.

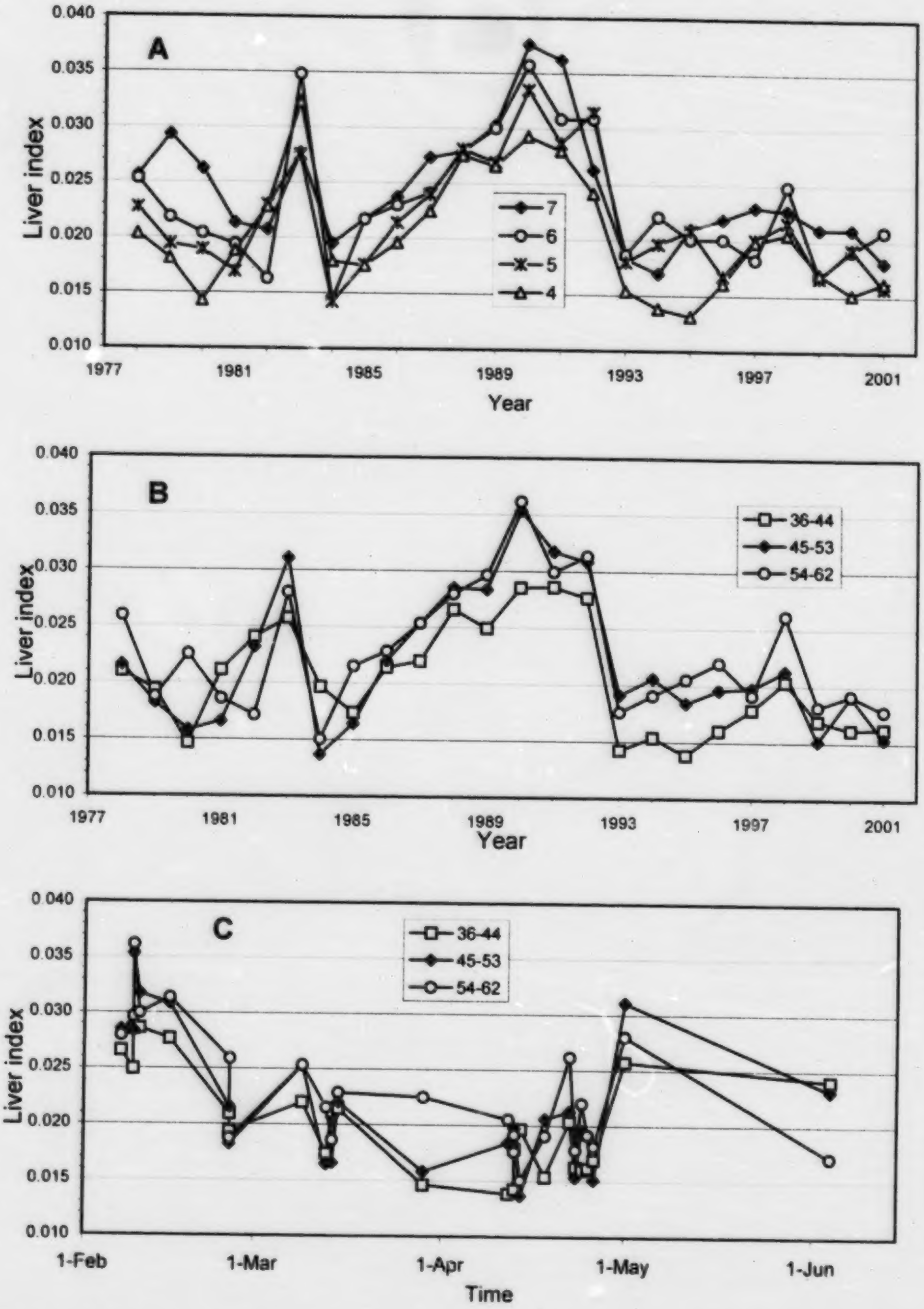


Fig. 21. Mean liver index of cod sampled during DFO bottom-trawl surveys in Subdivision 3Ps in 1978-2001; (A) by age and year, (B) by length-group and year, and (C) by length-group and median date of collectio

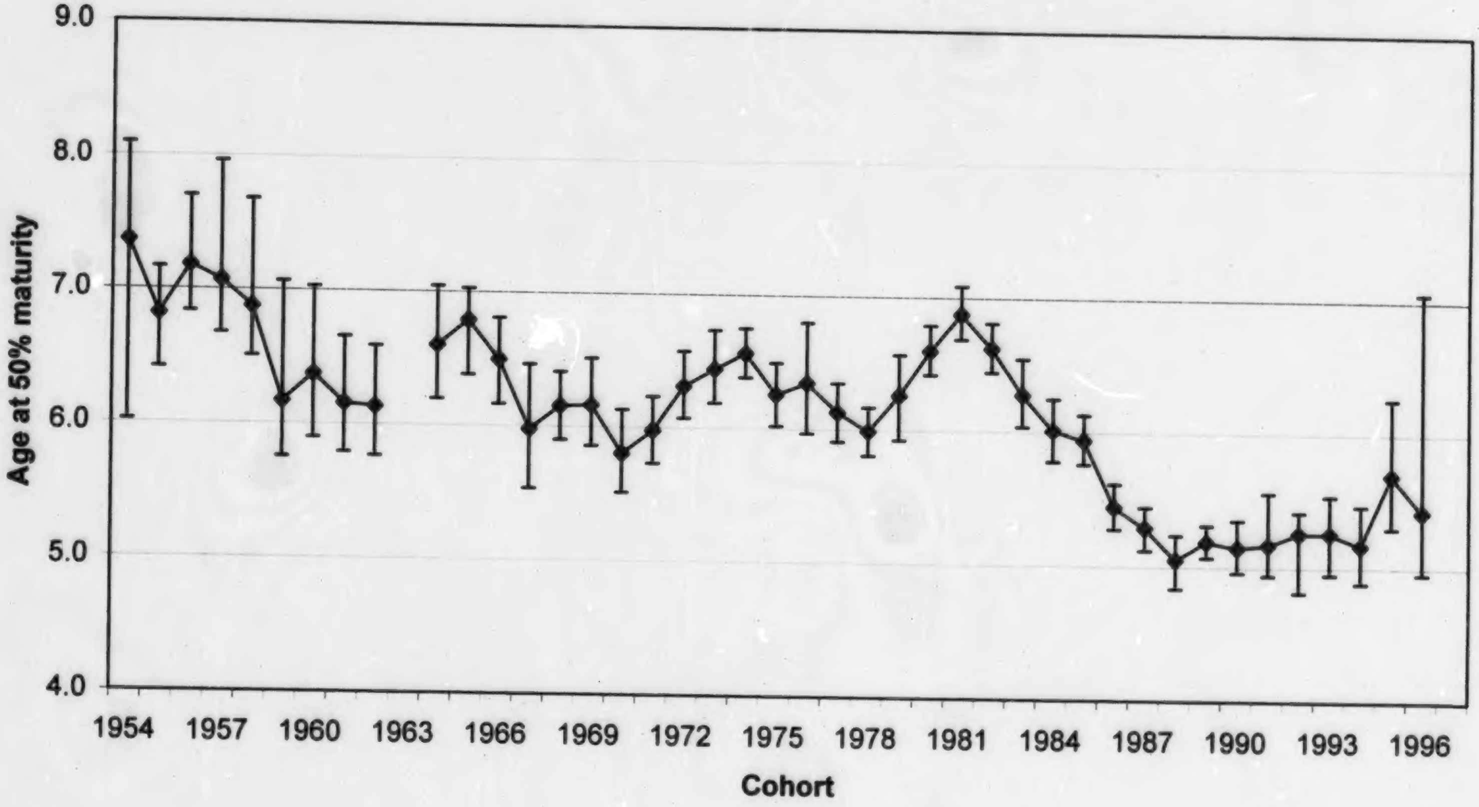


Fig. 22. Age at 50% maturity by cohort (1954-1996) for female cod sampled during DFO research vessel bottom-trawl surveys of NAFO Subdiv. 3Ps. Error bars are 95% confidence intervals.

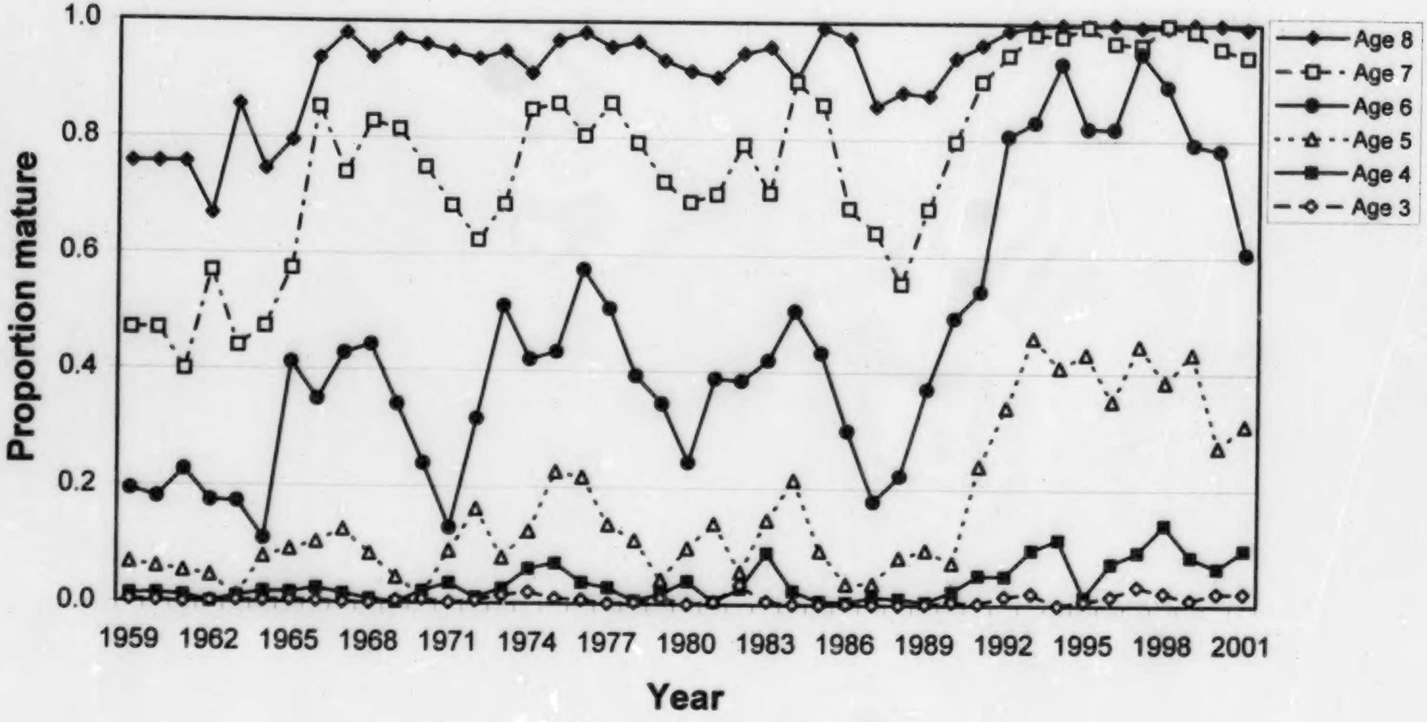
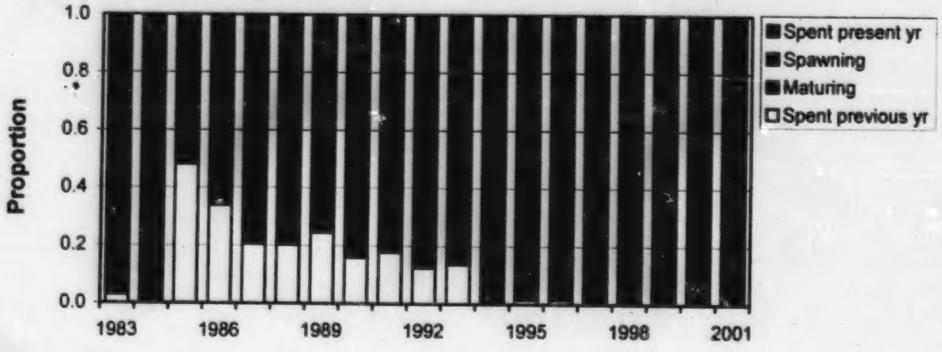
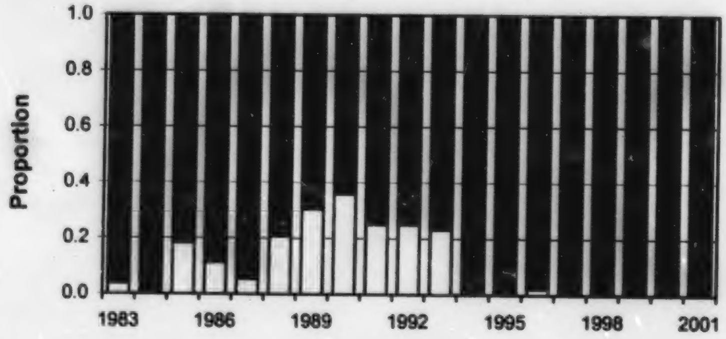


Fig. 23. Estimated proportions mature at ages 3-8 for female cod sampled during DFO research vessel bottom-trawl surveys in NAFO Subdiv. 3Ps during 1959-2001.

**Burgeo Bank / Hermitage Channel**



**Mid-3Ps (most of St. Pierre Bank)**



**Halibut Channel**

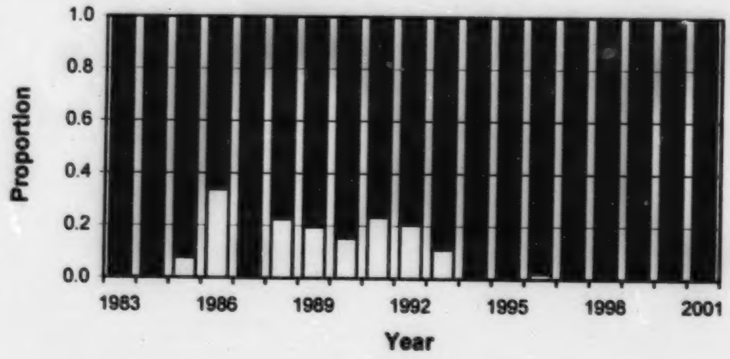


Fig. 24. Maturity stages of adult female cod sampled during DFO research vessel bottom-trawl surveys in three areas of 3Ps during winter/spring 1983-2001. There were two surveys in 1993 (Feb. and April); only the April one is shown here. Surveys were conducted in April in 1983, 1984 and 1993-2001 and in February-March in intervening years.

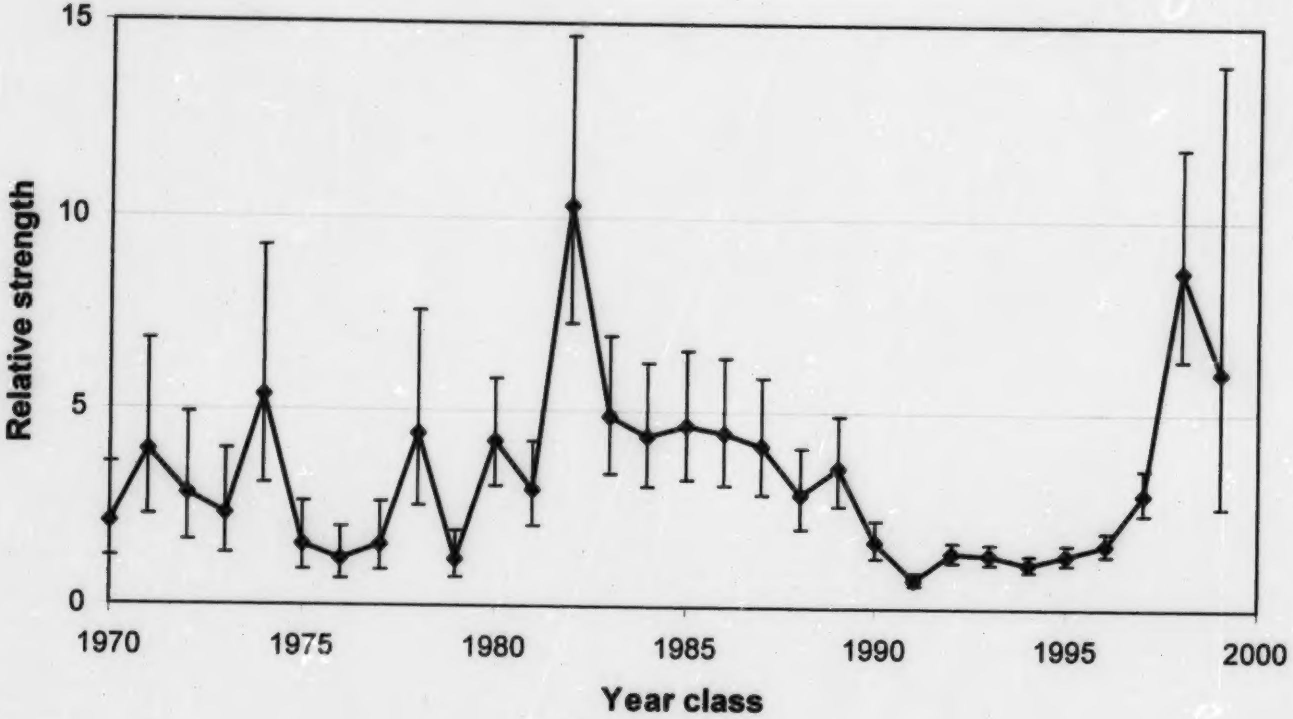


Fig. 25. Estimates of year class strength (±SE) from a log-additive model incorporating catch rates for ages 1-4 from various surveys.

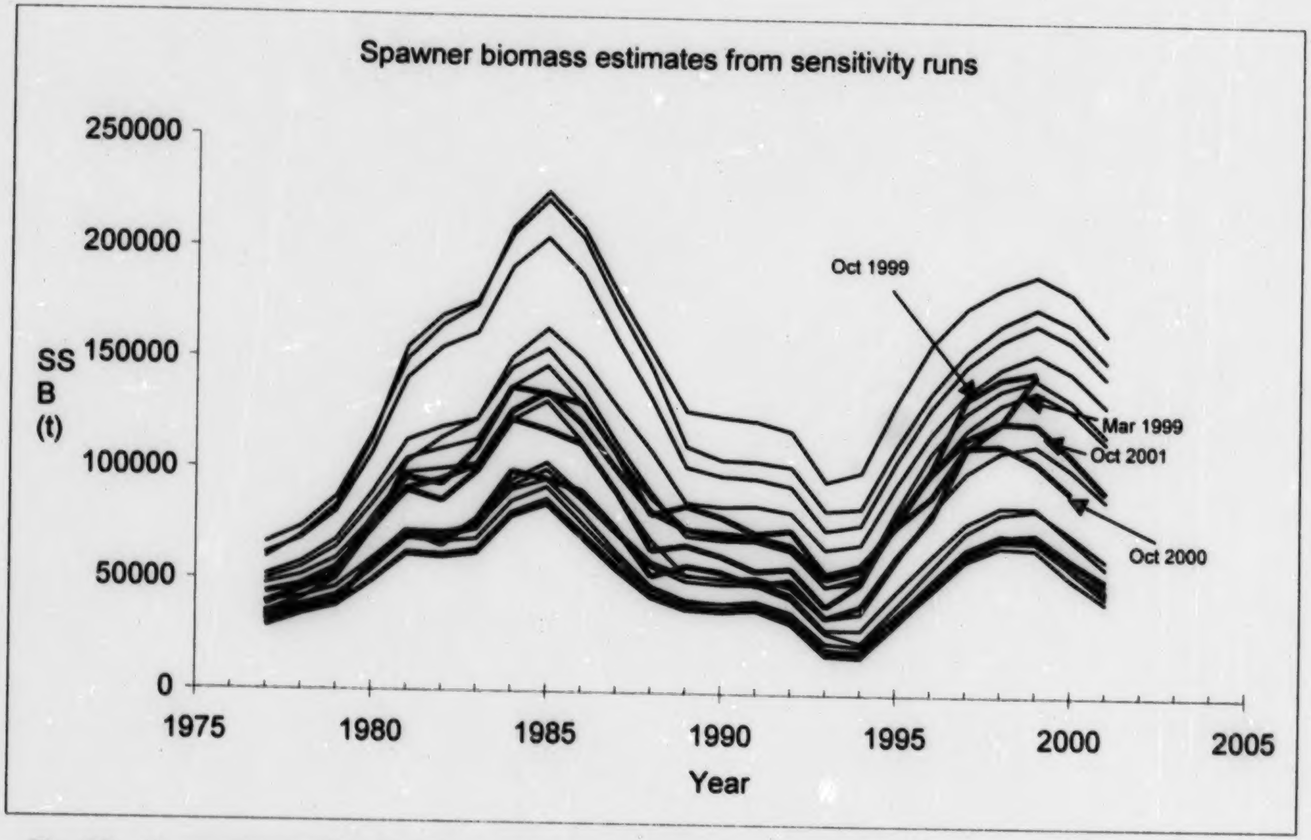


Fig. 26. Comparison of sensitivity runs for various SPA models (XSA, ADAPT, QLSPA) applied to the 3Ps cod data. Accepted model estimates from recent assessments are shown in bold

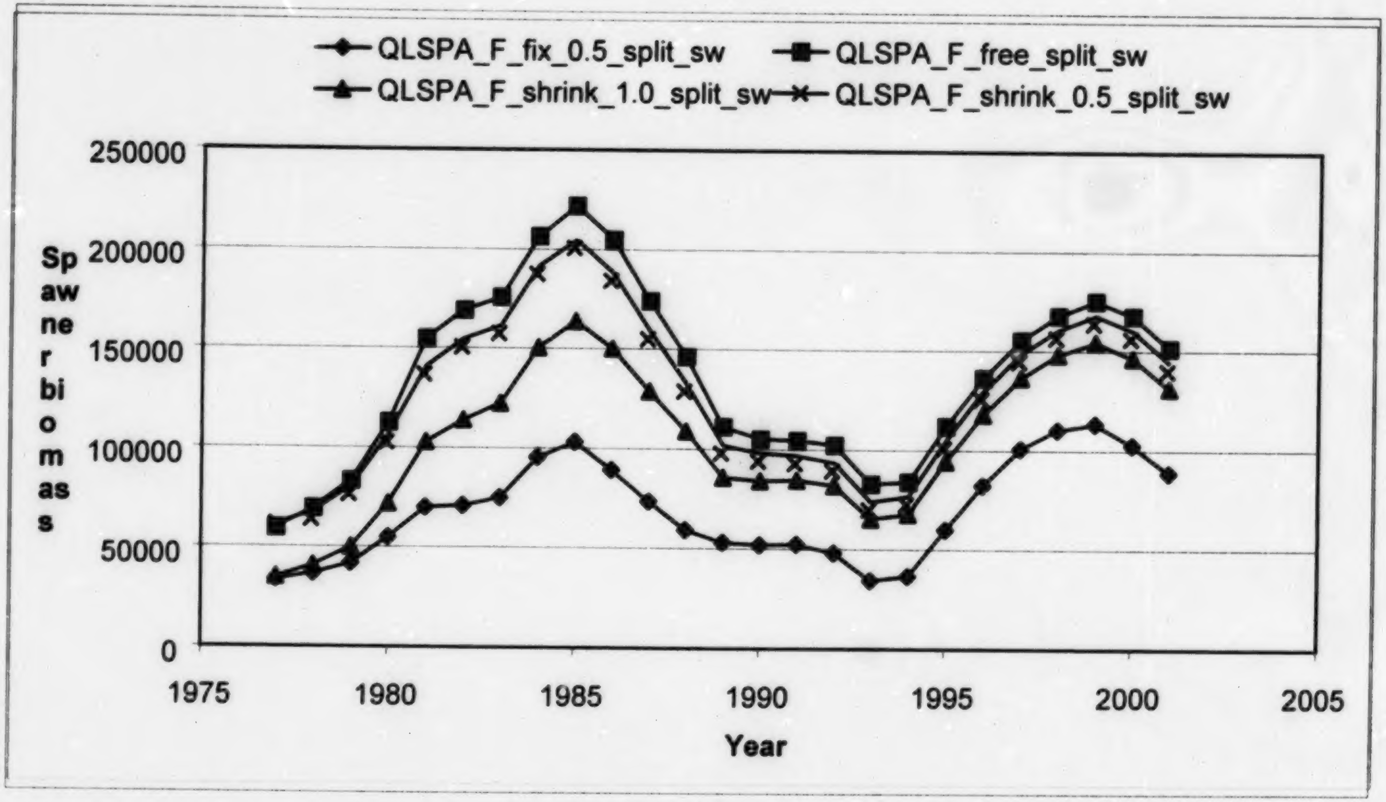


Fig.27. Comparison of results from four QLSPA formulations (self-weighted, split RV) which differed only in the treatment of the F on the oldest age.

Fig. 28. Graphical output from the QLSPA comparison run for 3Ps cod (identical formulation to the final model run in the October 2000 assessment with the addition of one more year of data)

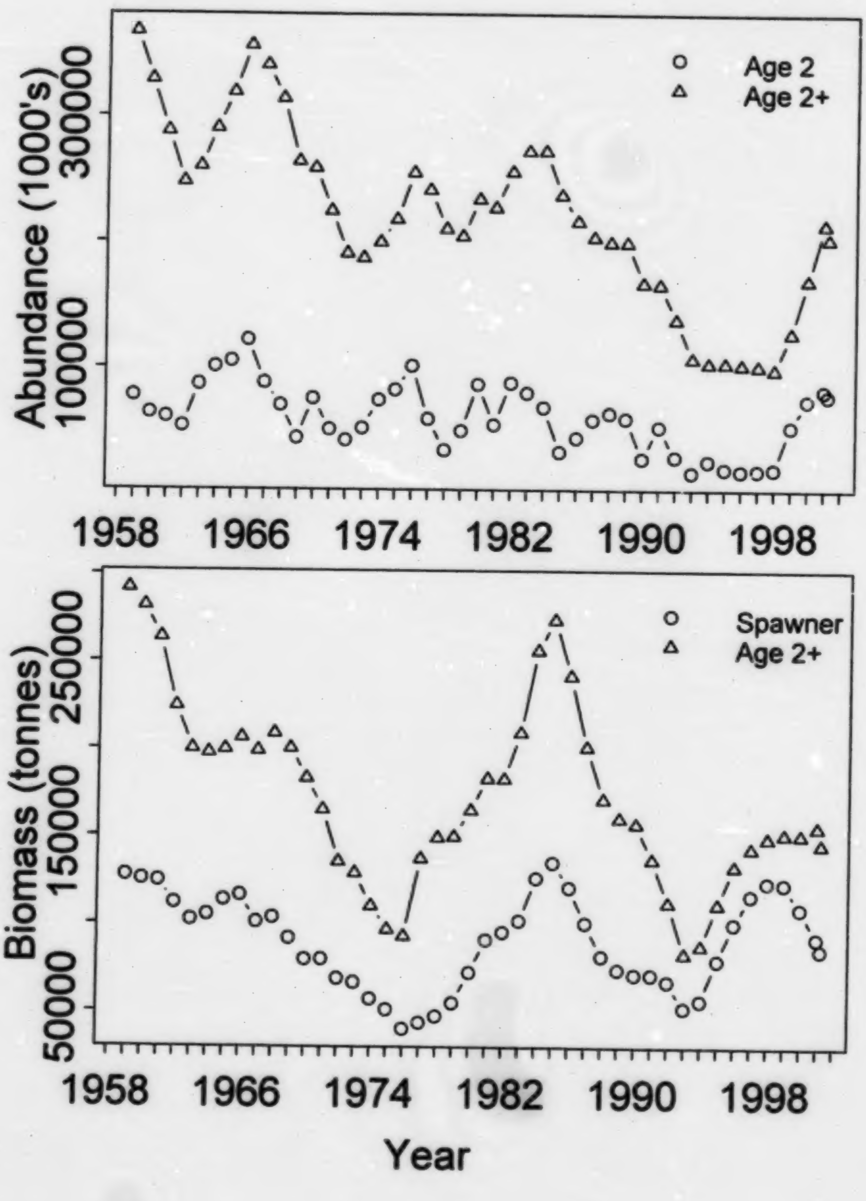


Fig. 28. Cont'd.

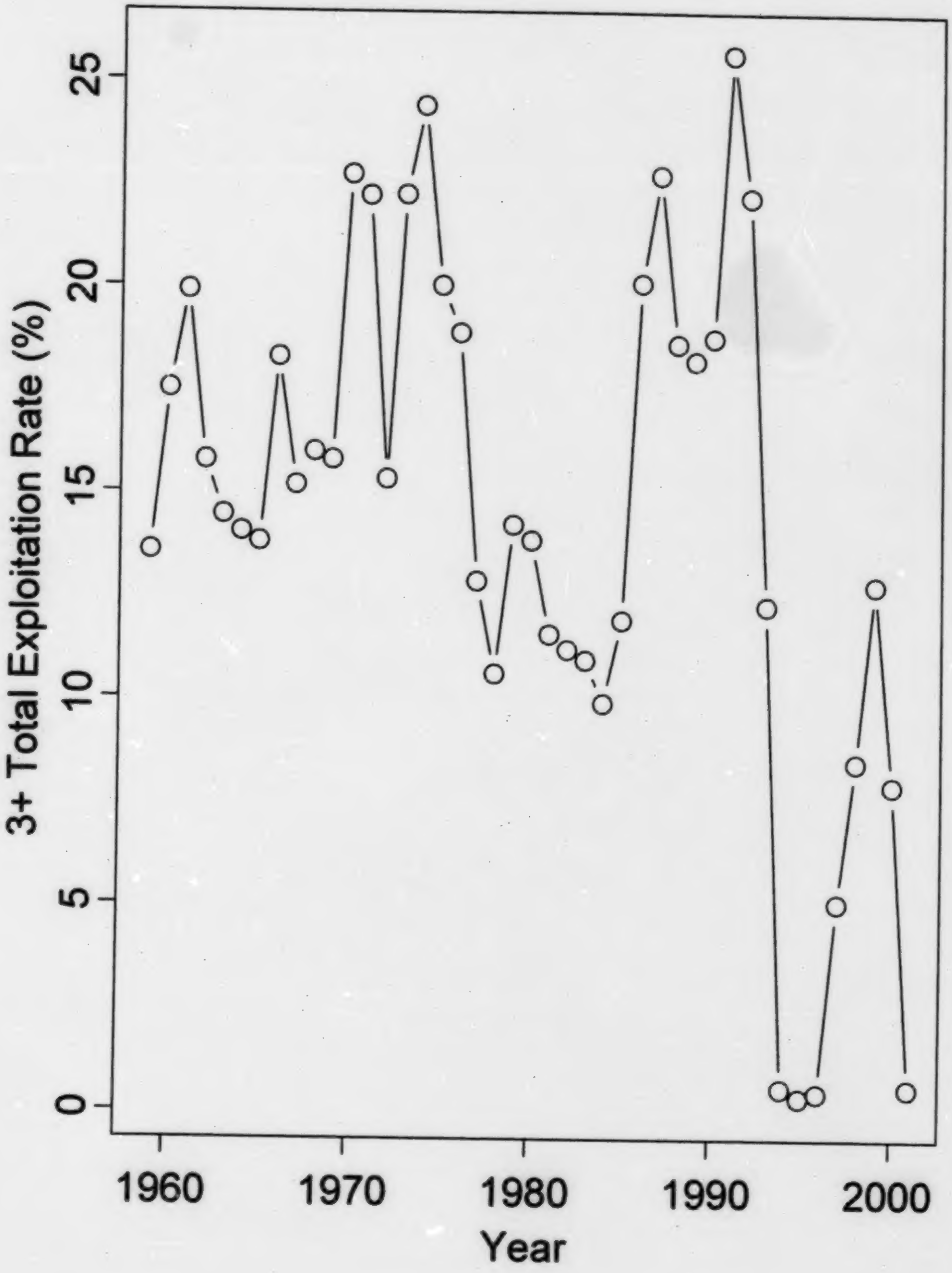

3+ Total Exploitation Rate (%)
0
5
10
15
20
25
1960
1970
1980
1990
2000
Year

Fig. 28. Cont'd.

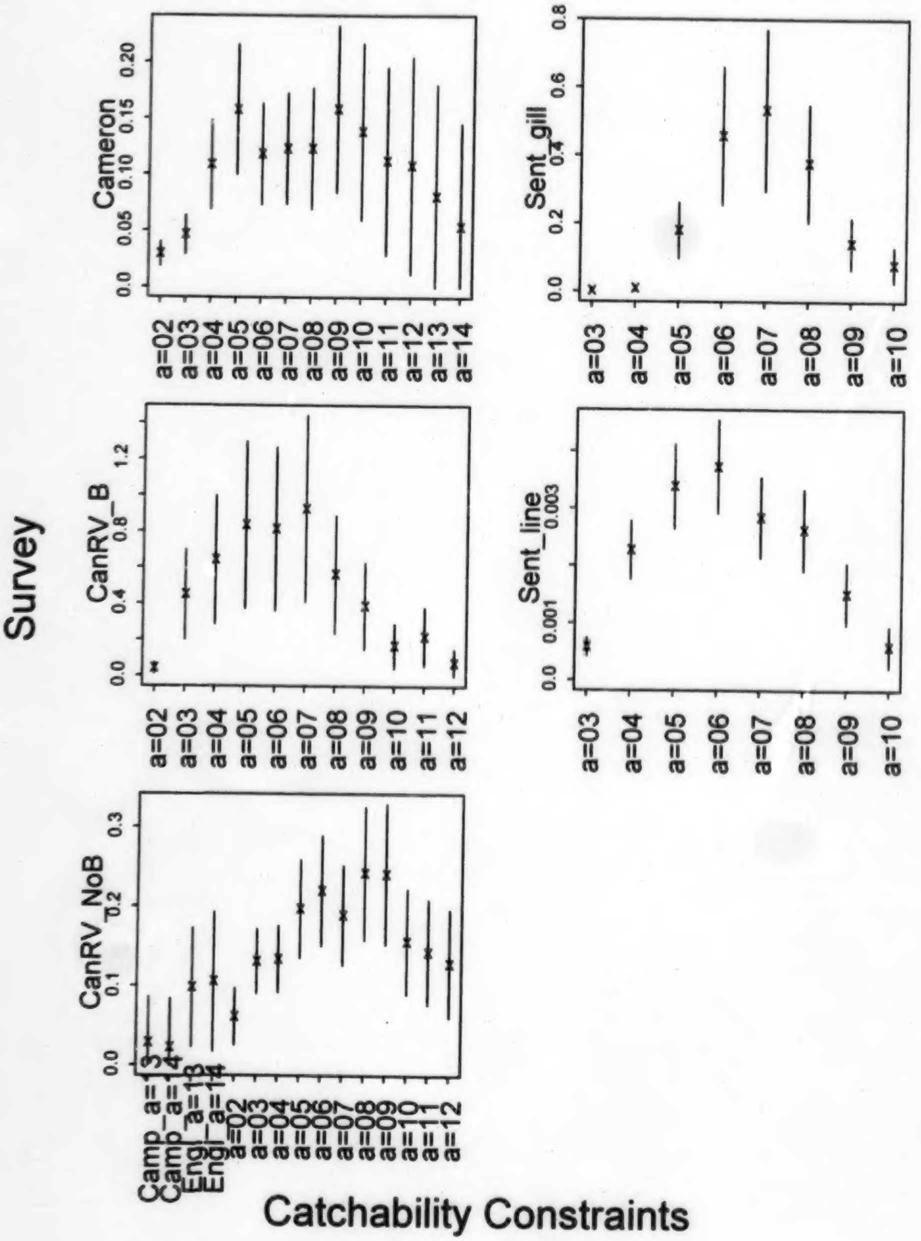

Survey
Catchability Constraints
Cameron
0.0
0.05
0.10
0.15
0.20
a=02
a=03
a=04
a=05
a=06
a=07
a=08
a=09
a=10
a=11
a=12
a=13
a=14
CanRV_B
0.0
0.4
0.8
1.2
a=02
a=03
a=04
a=05
a=06
a=07
a=08
a=09
a=10
a=11
a=12
CanRV_NoB
0.0
0.1
0.2
0.3
Camp_a=13
Camp_a=14
Engl_a=13
Engl_a=14
a=02
a=03
a=04
a=05
a=06
a=07
a=08
a=09
a=10
a=11
a=12
Sent_gill
0.0
0.2
0.4
0.6
0.8
a=03
a=04
a=05
a=06
a=07
a=08
a=09
a=10
Sent_line
0.0
0.001
0.003
a=03
a=04
a=05
a=06
a=07
a=08
a=09
a=10

Fig. 28. Cont'd.

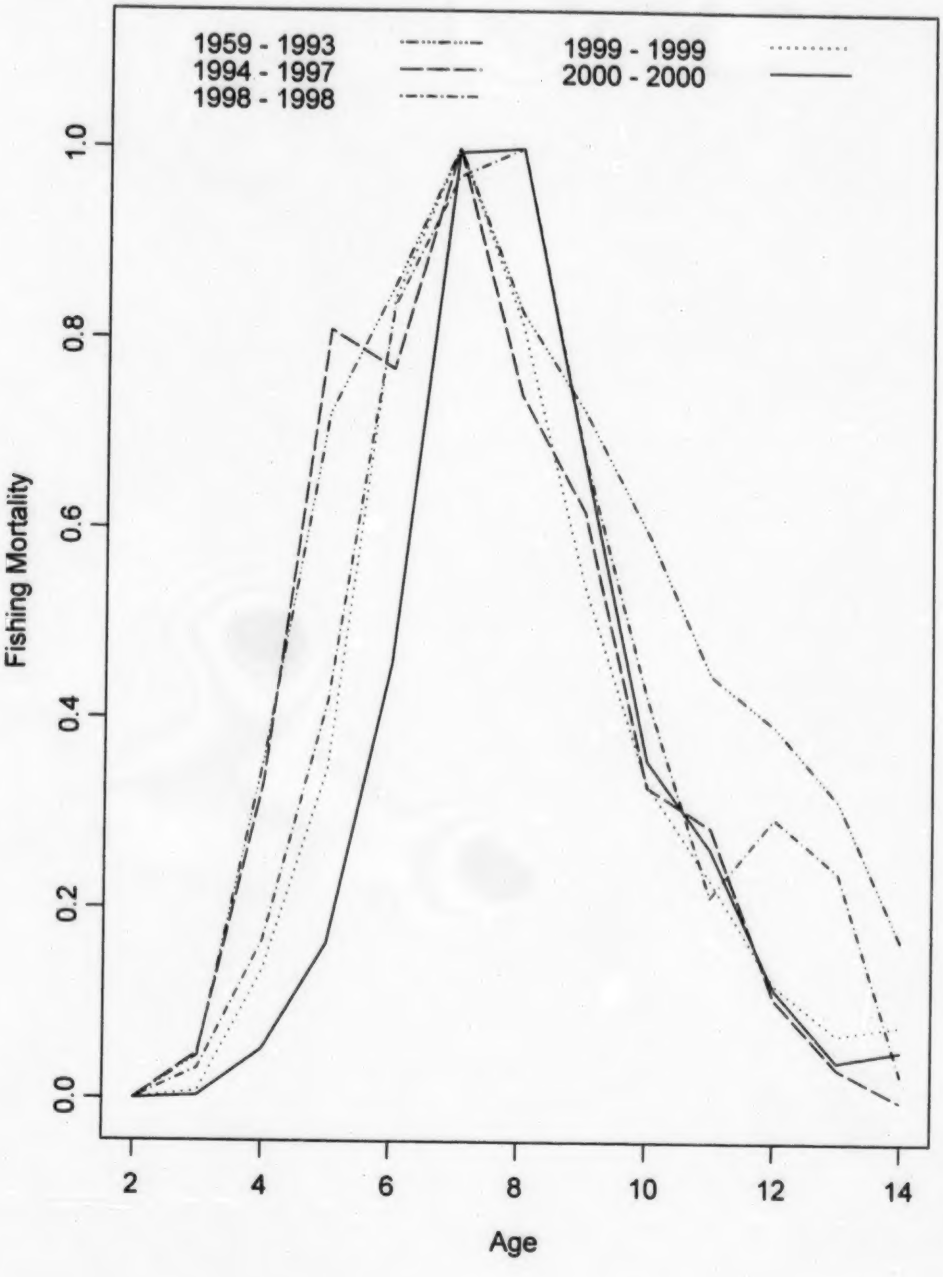

1959 - 1993
1994 - 1997
1998 - 1998
1999 - 1999
2000 - 2000
Fishing Mortality
0.0
0.2
0.4
0.6
0.8
1.0
2
4
6
8
10
12
14
Age

Fig. 28. Cont'd.

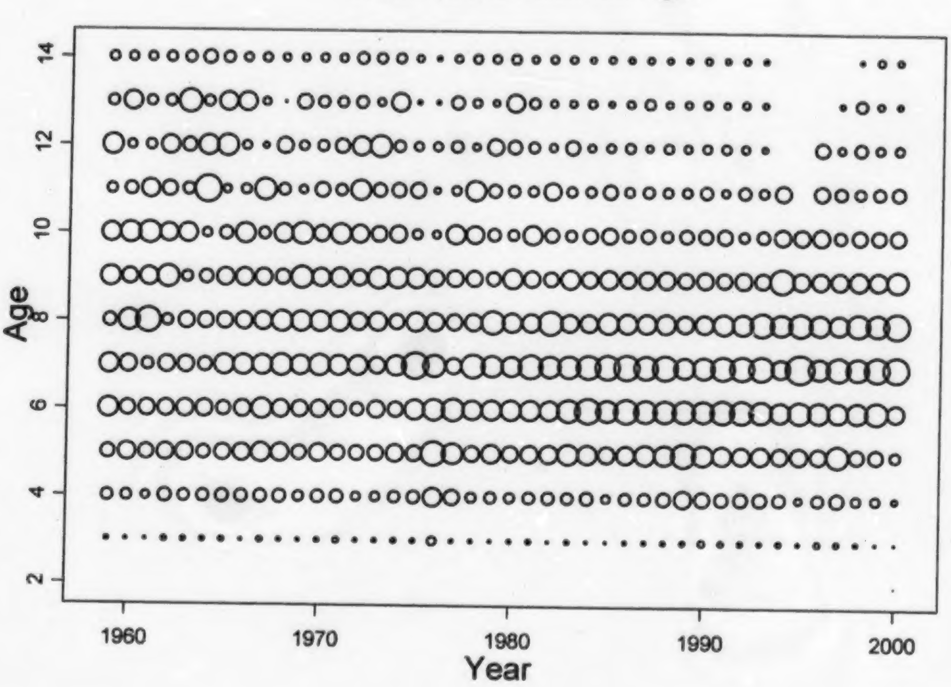

Partial Recruitment at Age
Age
2
4
6
8
10
12
14
Year
1960
1970
1980
1990
2000

Fig. 28. Cont'd

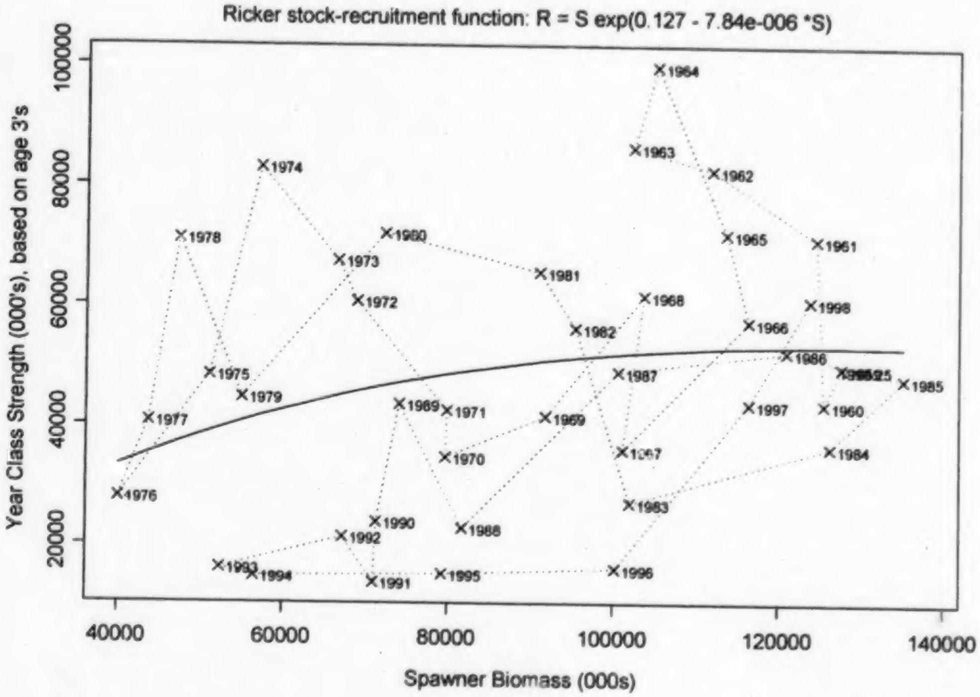

Ricker stock-recruitment function: R = S exp(0.127 - 7.84e-006 *S)
Year Class Strength (000's), based on age 3's
100000
80000
60000
40000
20000
Spawner Biomass (000s)
40000
60000
80000
100000
120000
140000
1964
1963
1962
1974
1978
1980
1965
1961
1973
1981
1972
1968
1998
1982
1966
1986
1975
1987
1985
1979
1989
1971
1977
1969
1997
1960
1970
1967
1984
1976
1983
1990
1988
1992
1993
1994
1991
1995
1996

Fig. 28. Cont'd.

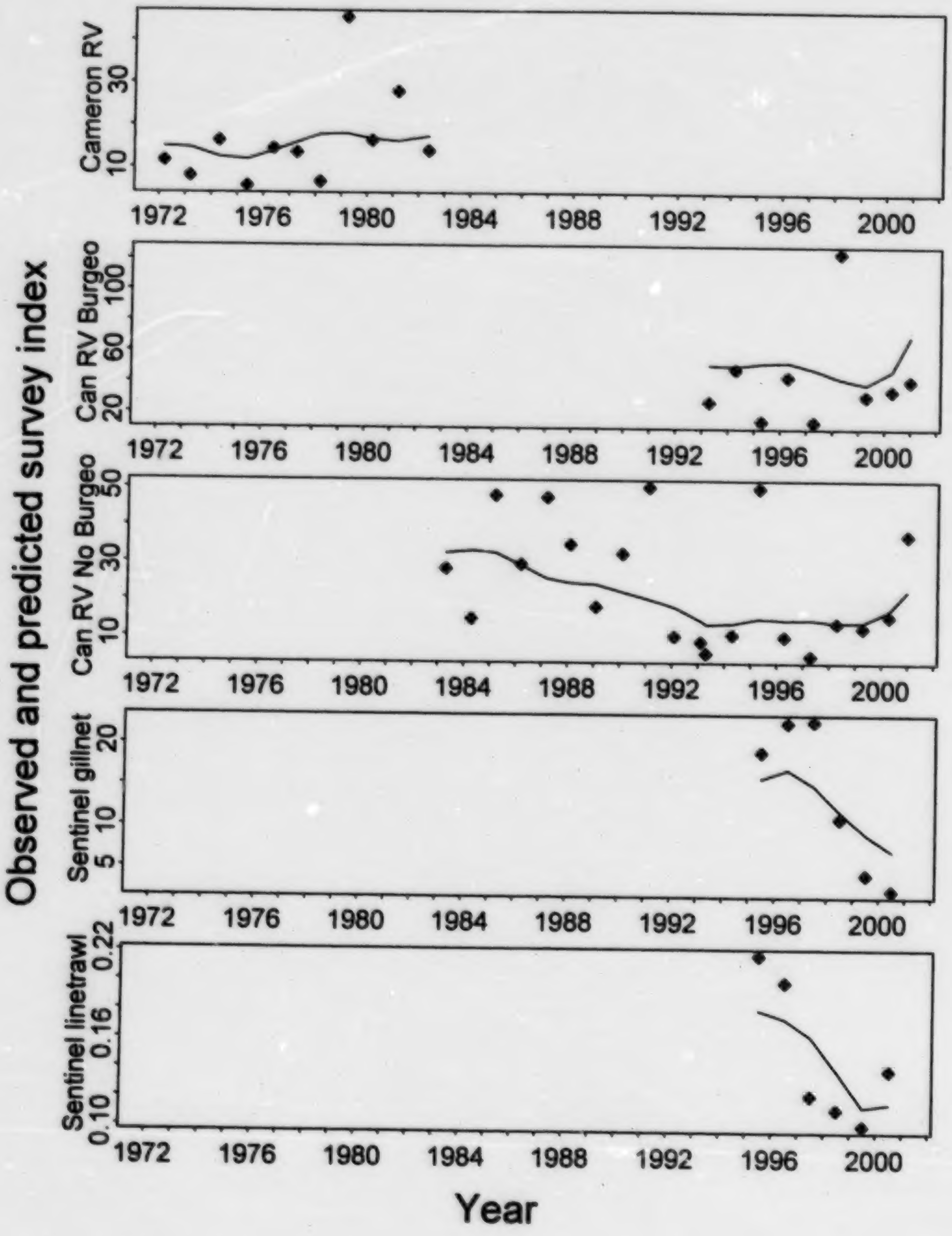

Observed and predicted survey index
Cameron RV
10
30
Can RV Burgeo
20
60
100
Can RV No Burgeo
10
30
50
Sentinel gillnet
5
10
20
Sentinel linetrawl
0.10
0.16
0.22
1972
1976
1980
1984
1988
1992
1996
2000
Year

Fig. 28. Cont'd.

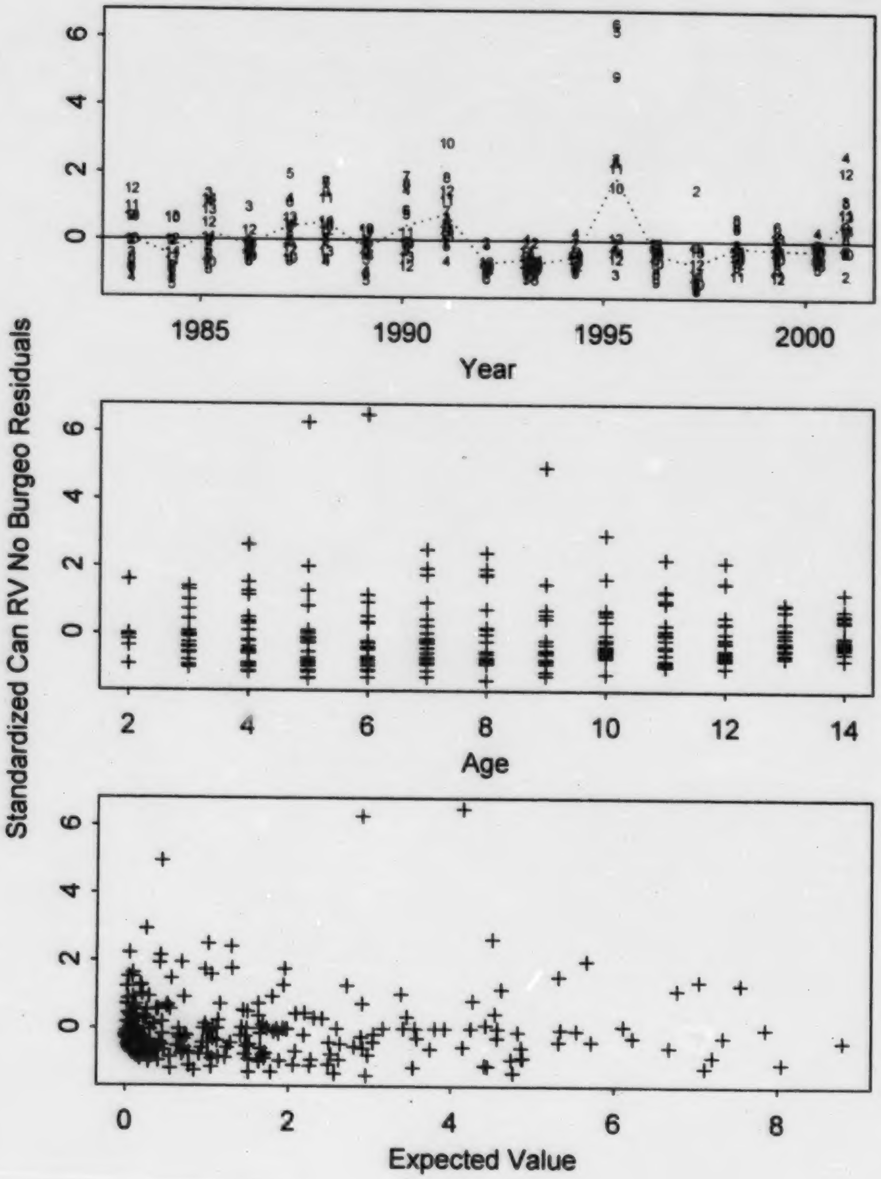

Standardized Can RV No Burgeo Residuals
0
2
4
6
1985
1990
1995
2000
Year
2
4
6
8
10
12
14
Age
0
2
4
6
8
Expected Value

Fig. 28. Cont'd.

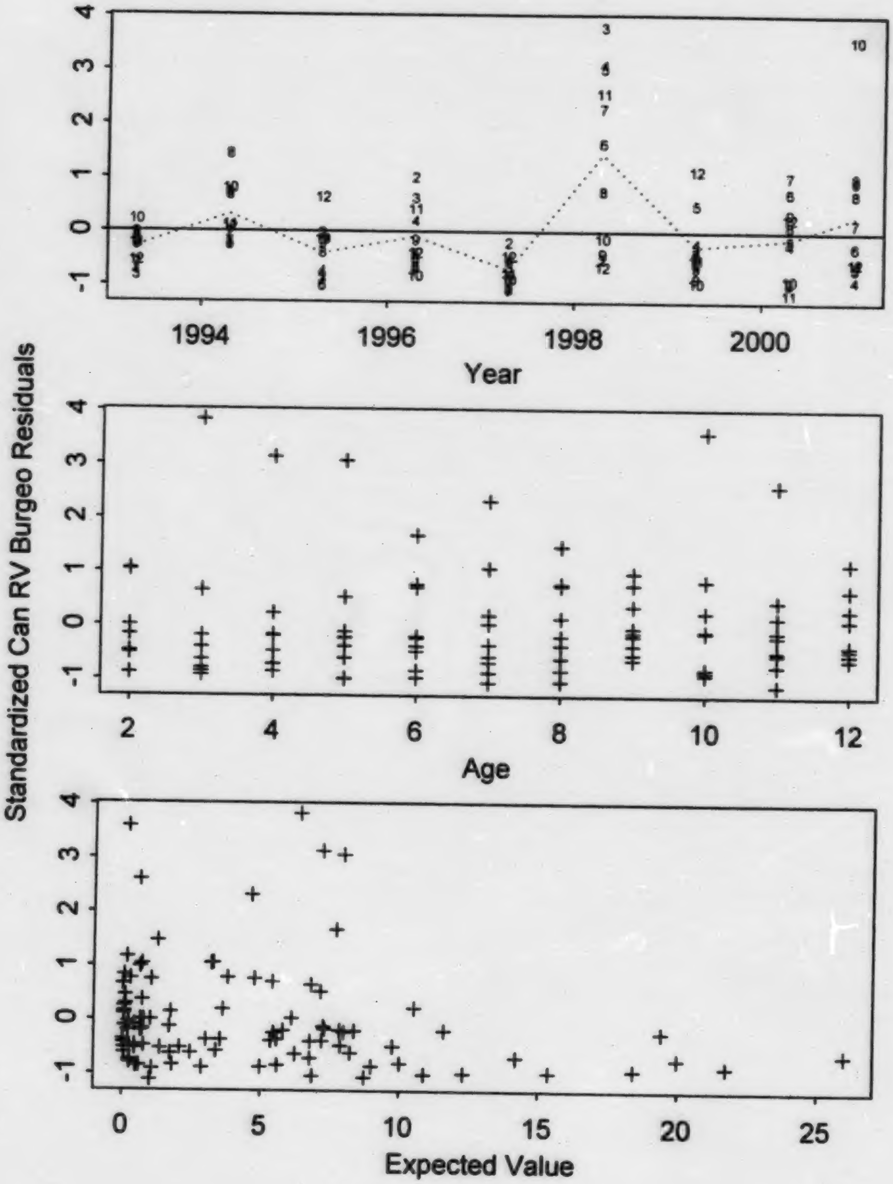

Standardized Can RV Burgeo Residuals
4
3
2
1
0
-1
1994
1996
1998
2000
Year
2
4
6
8
10
12
Age
0
5
10
15
20
25
Expected Value

Fig. 28. Cont'd.

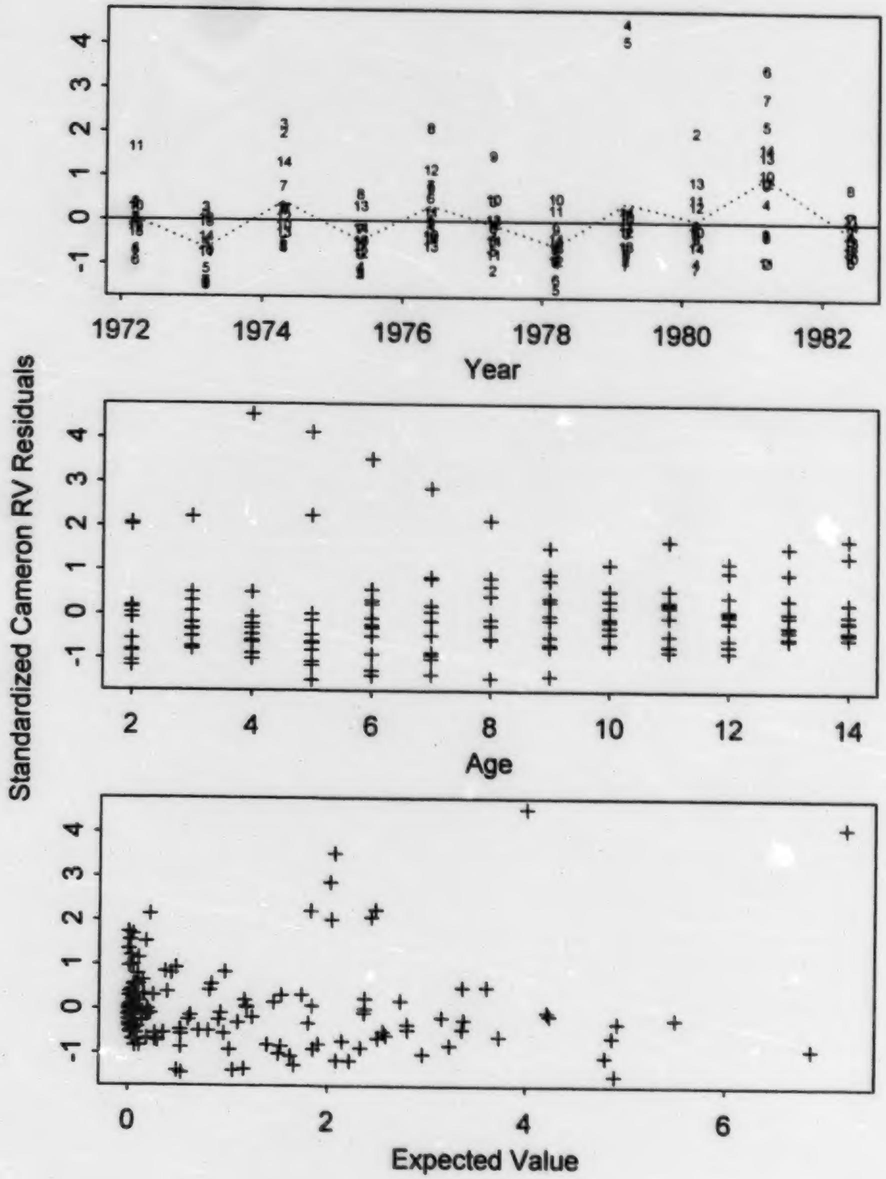

Standardized Cameron RV Residuals
-1
0
1
2
3
4
1972
1974
1976
1978
1980
1982
Year
2
4
6
8
10
12
14
Age
0
2
4
6
Expected Value

Fig. 28. Cont'd.

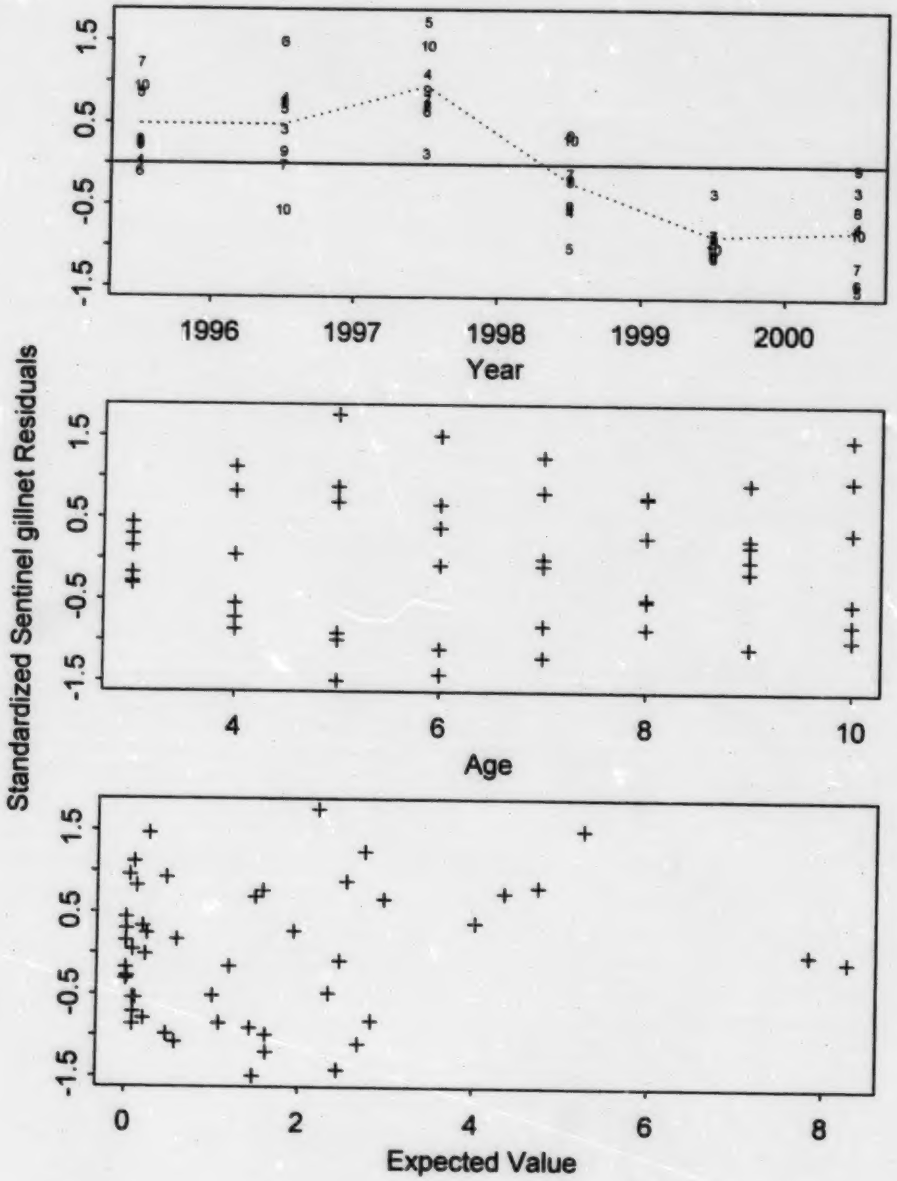

Standardized Sentinel gillnet Residuals
1.5
0.5
-0.5
-1.5
1996
1997
1998
1999
2000
Year
4
6
8
10
Age
0
2
4
6
8
Expected Value

Fig. 28. Cont'd.

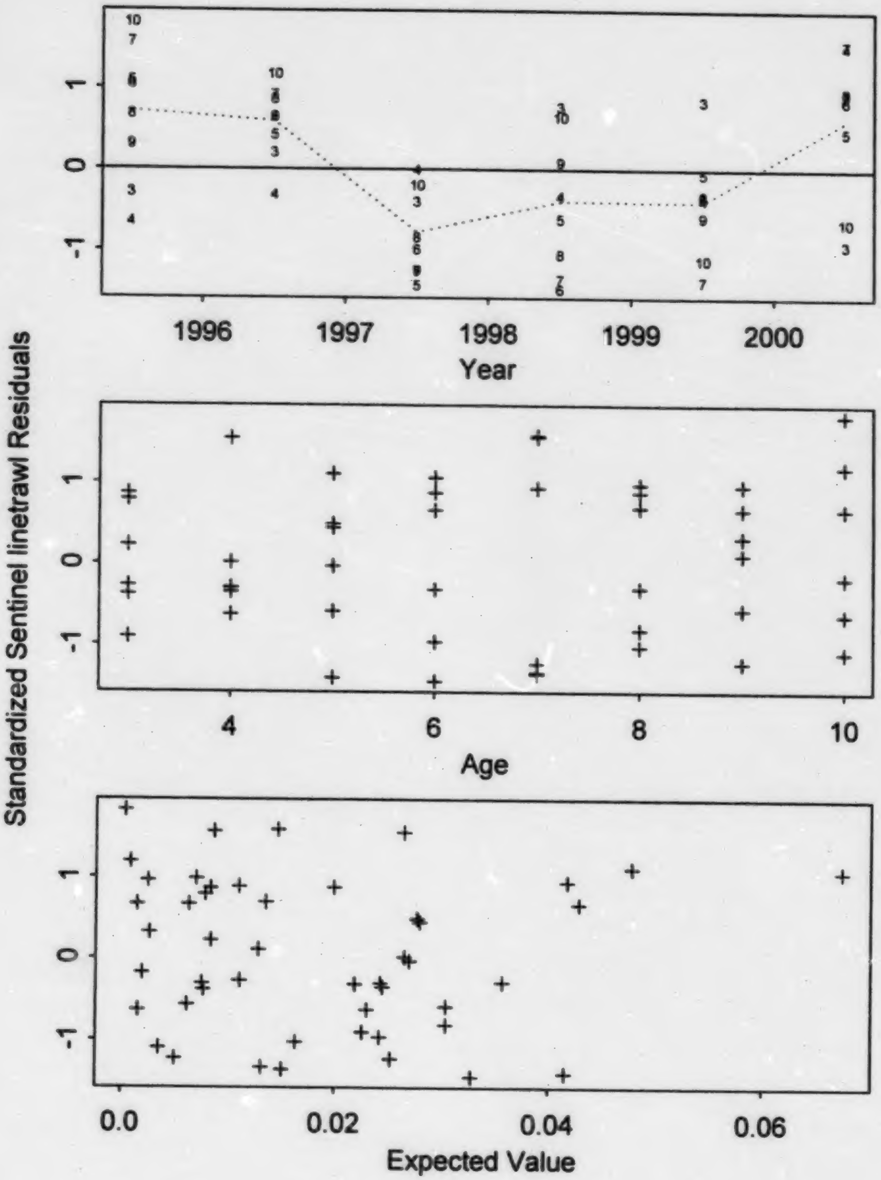

Standardized Sentinel linetrawl Residuals
1
0
-1
1996
1997
1998
1999
2000
Year
4
6
8
10
Age
0.0
0.02
0.04
0.06
Expected Value

Fig. 28. Cont'd.

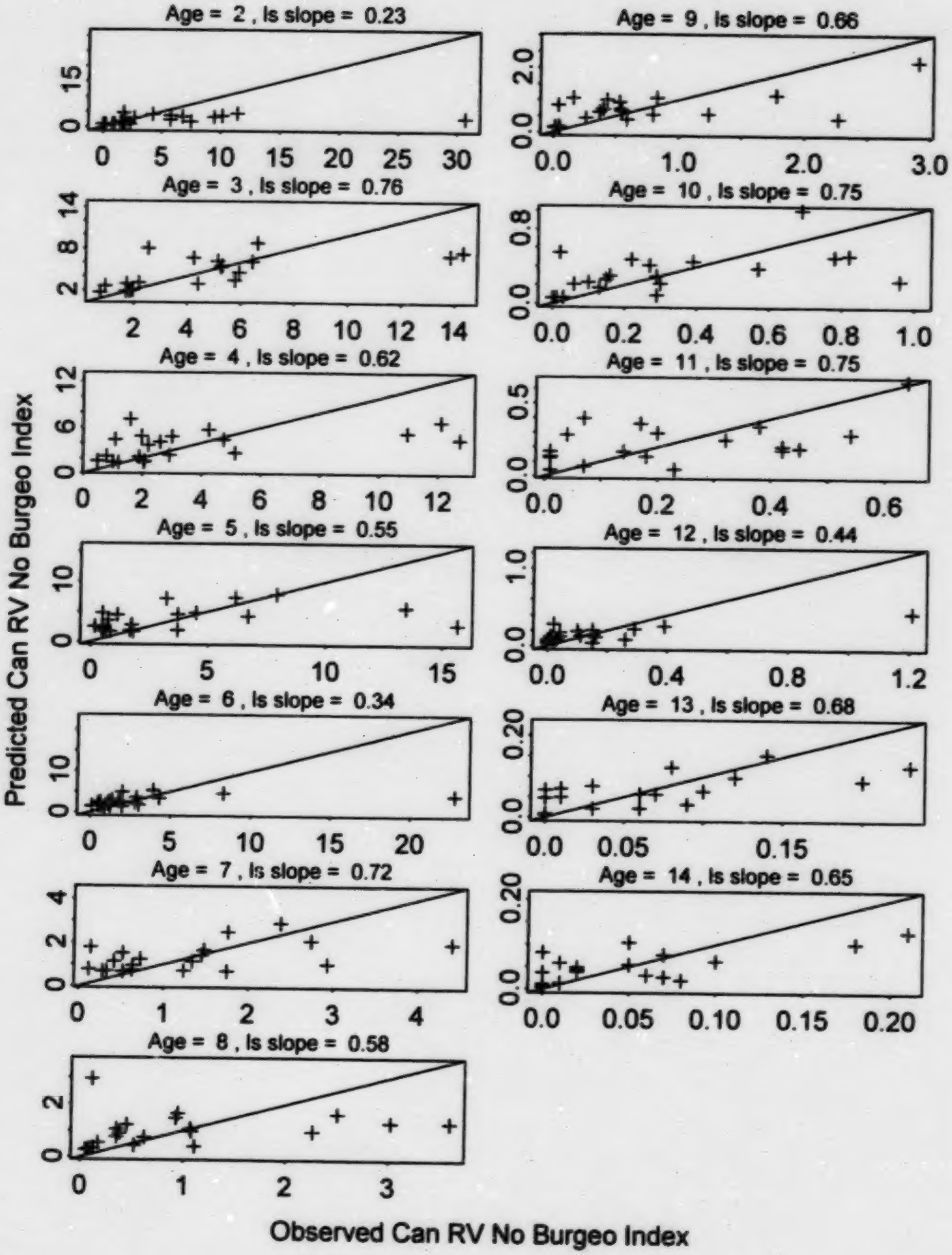
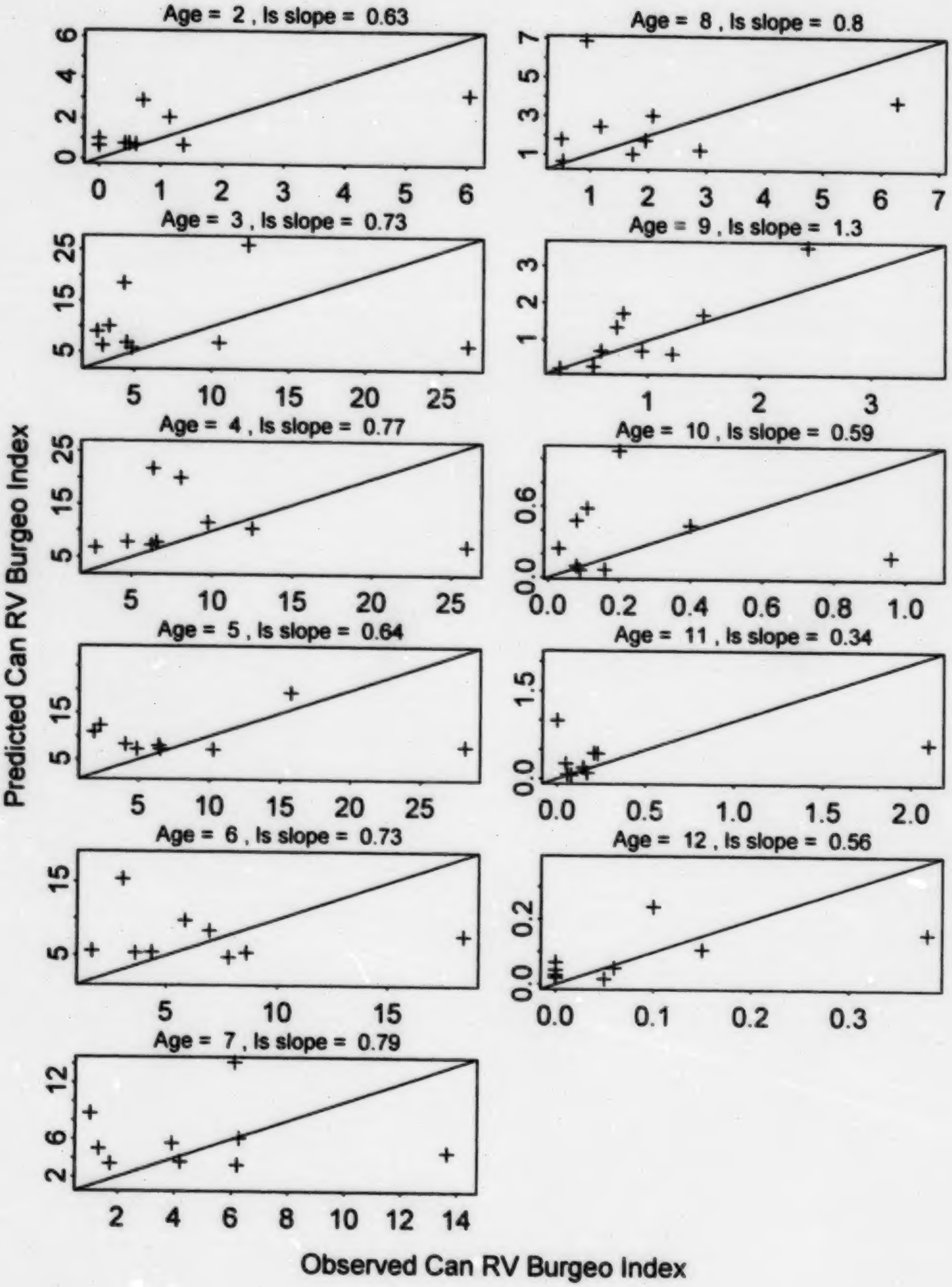

Age = 2 , ls slope = 0.23
Age = 3 , ls slope = 0.76
Age = 4 , ls slope = 0.62
Age = 5 , ls slope = 0.55
Age = 6 , ls slope = 0.34
Age = 7 , ls slope = 0.72
Age = 8 , ls slope = 0.58
Age = 9 , ls slope = 0.66
Age = 10 , ls slope = 0.75
Age = 11 , ls slope = 0.75
Age = 12 , ls slope = 0.44
Age = 13 , ls slope = 0.68
Age = 14 , ls slope = 0.65
Predicted Can RV No Burgeo Index
Observed Can RV No Burgeo Index

Fig. 28. Cont'd.



Age = 2 , ls slope = 0.63

Age = 3 , ls slope = 0.73

Age = 4 , ls slope = 0.77

Age = 5 , ls slope = 0.64

Age = 6 , ls slope = 0.73

Age = 7 , ls slope = 0.79

Age = 8 , ls slope = 0.8

Age = 9 , ls slope = 1.3

Age = 10 , ls slope = 0.59

Age = 11 , ls slope = 0.34

Age = 12 , ls slope = 0.56

Fig. 28. Cont'd.

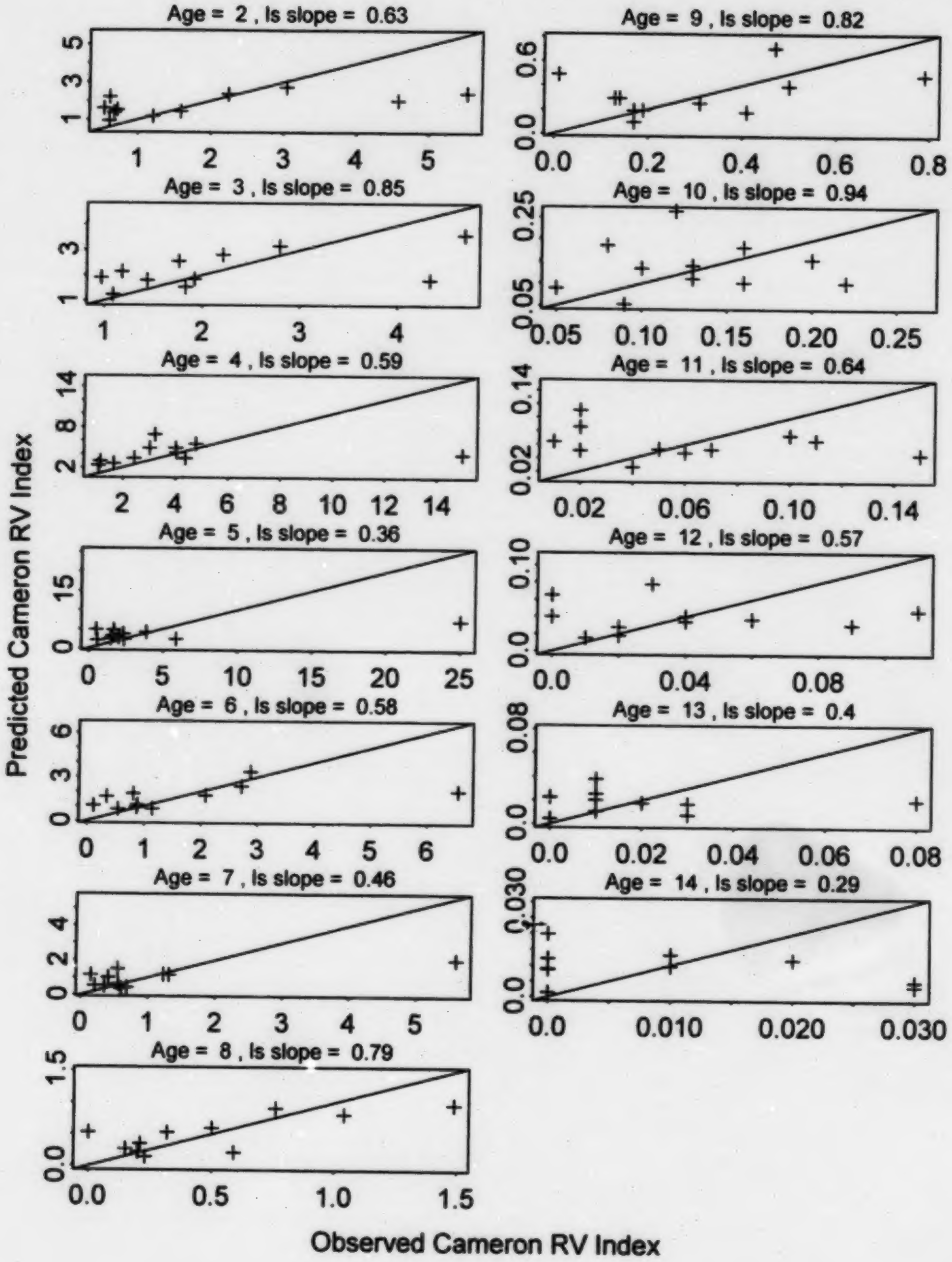

Age = 2 , ls slope = 0.63
1 3 5
1 2 3 4 5
Age = 3 , ls slope = 0.85
1 3
1 2 3 4
Age = 4 , ls slope = 0.59
2 8 14
2 4 6 8 10 12 14
Age = 5 , ls slope = 0.36
0 15
0 5 10 15 20 25
Age = 6 , ls slope = 0.58
0 3 6
0 1 2 3 4 5 6
Age = 7 , ls slope = 0.46
0 2 4
0 1 2 3 4 5
Age = 8 , ls slope = 0.79
0.0 1.5
0.0 0.5 1.0 1.5
Age = 9 , ls slope = 0.82
0.0 0.6
0.0 0.2 0.4 0.6 0.8
Age = 10 , ls slope = 0.94
0.05 0.25
0.05 0.10 0.15 0.20 0.25
Age = 11 , ls slope = 0.64
0.02 0.14
0.02 0.06 0.10 0.14
Age = 12 , ls slope = 0.57
0.0 0.10
0.0 0.04 0.08
Age = 13 , ls slope = 0.4
0.0 0.08
0.0 0.02 0.04 0.06 0.08
Age = 14 , ls slope = 0.29
0.0 0.030
0.0 0.010 0.020 0.030
Predicted Cameron RV Index
Observed Cameron RV Index

Fig. 28. Cont'd.

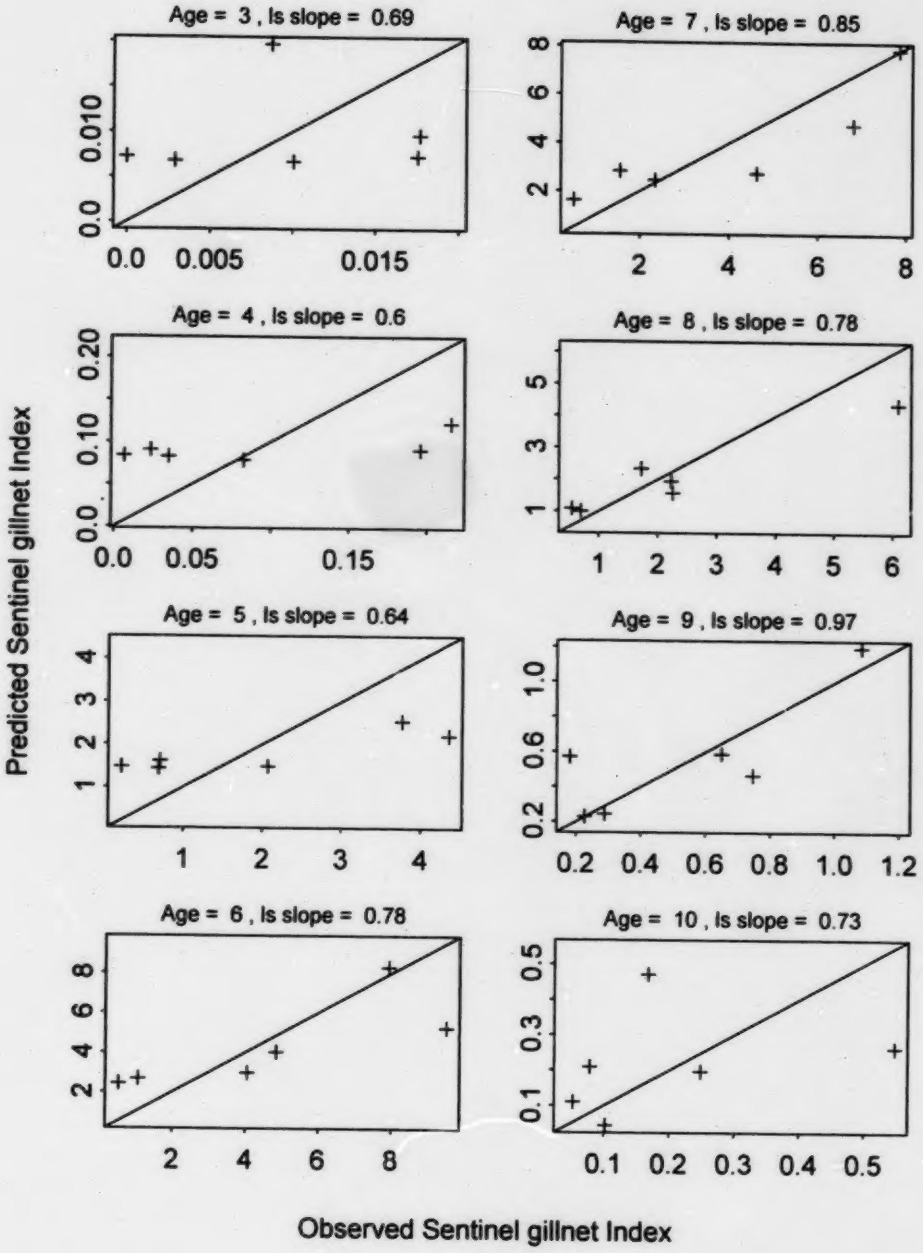

Age = 3 , ls slope = 0.69
Age = 4 , ls slope = 0.6
Age = 5 , ls slope = 0.64
Age = 6 , ls slope = 0.78
Age = 7 , ls slope = 0.85
Age = 8 , ls slope = 0.78
Age = 9 , ls slope = 0.97
Age = 10 , ls slope = 0.73
Predicted Sentinel gillnet Index
Observed Sentinel gillnet Index

Fig. 28. Cont'd.

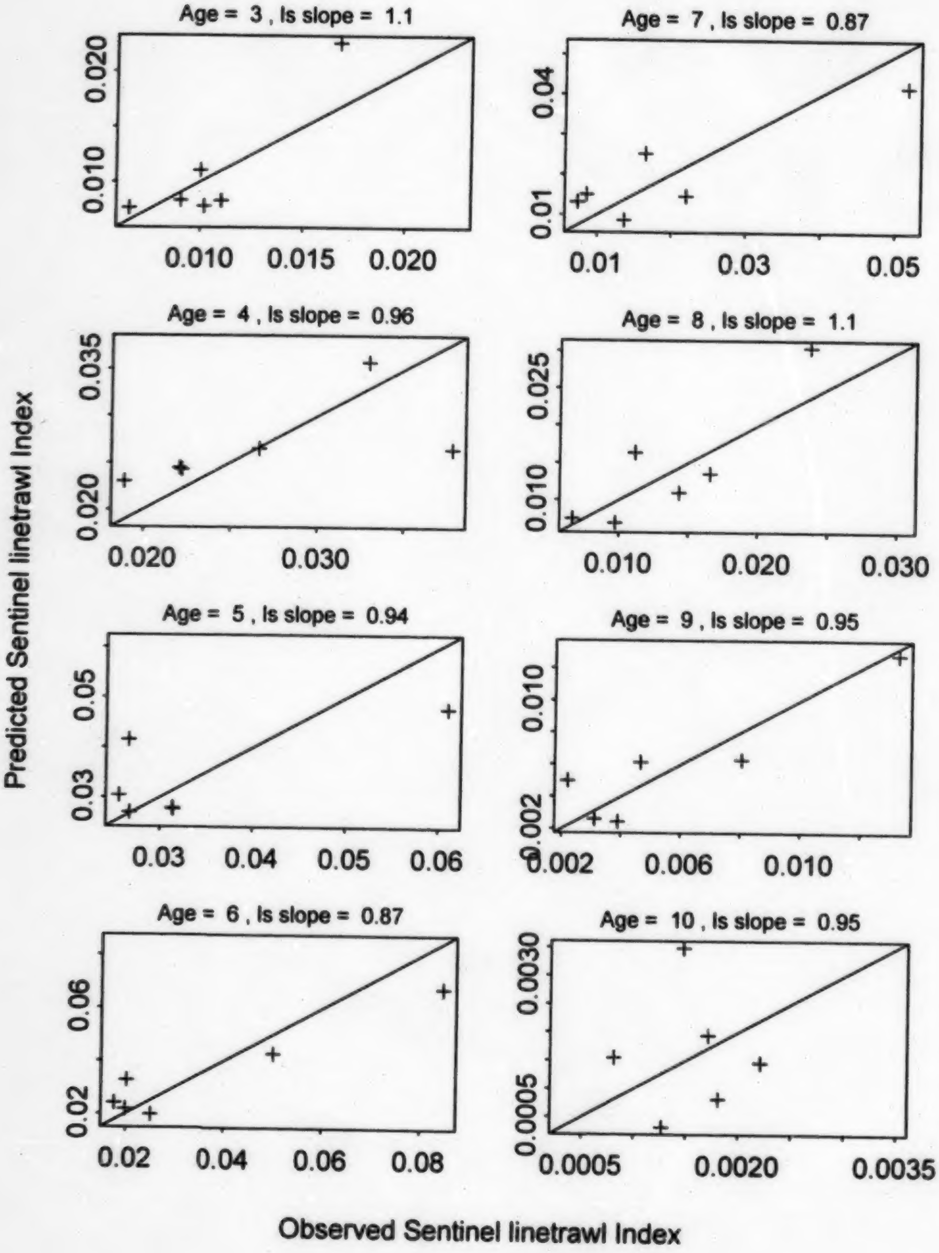

Age = 3 , ls slope = 1.1
0.010
0.020
0.010
0.015
0.020
Age = 7 , ls slope = 0.87
0.01
0.04
0.01
0.03
0.05
Age = 4 , ls slope = 0.96
0.020
0.035
0.020
0.030
Age = 8 , ls slope = 1.1
0.010
0.025
0.010
0.020
0.030
Age = 5 , ls slope = 0.94
0.03
0.05
0.03
0.04
0.05
0.06
Age = 9 , ls slope = 0.95
0.002
0.010
0.002
0.006
0.010
Age = 6 , ls slope = 0.87
0.02
0.06
0.02
0.04
0.06
0.08
Age = 10 , ls slope = 0.95
0.0005
0.0030
0.0005
0.0020
0.0035
Predicted Sentinel linetrawl Index
Observed Sentinel linetrawl Index

Fig. 28. Cont'd.

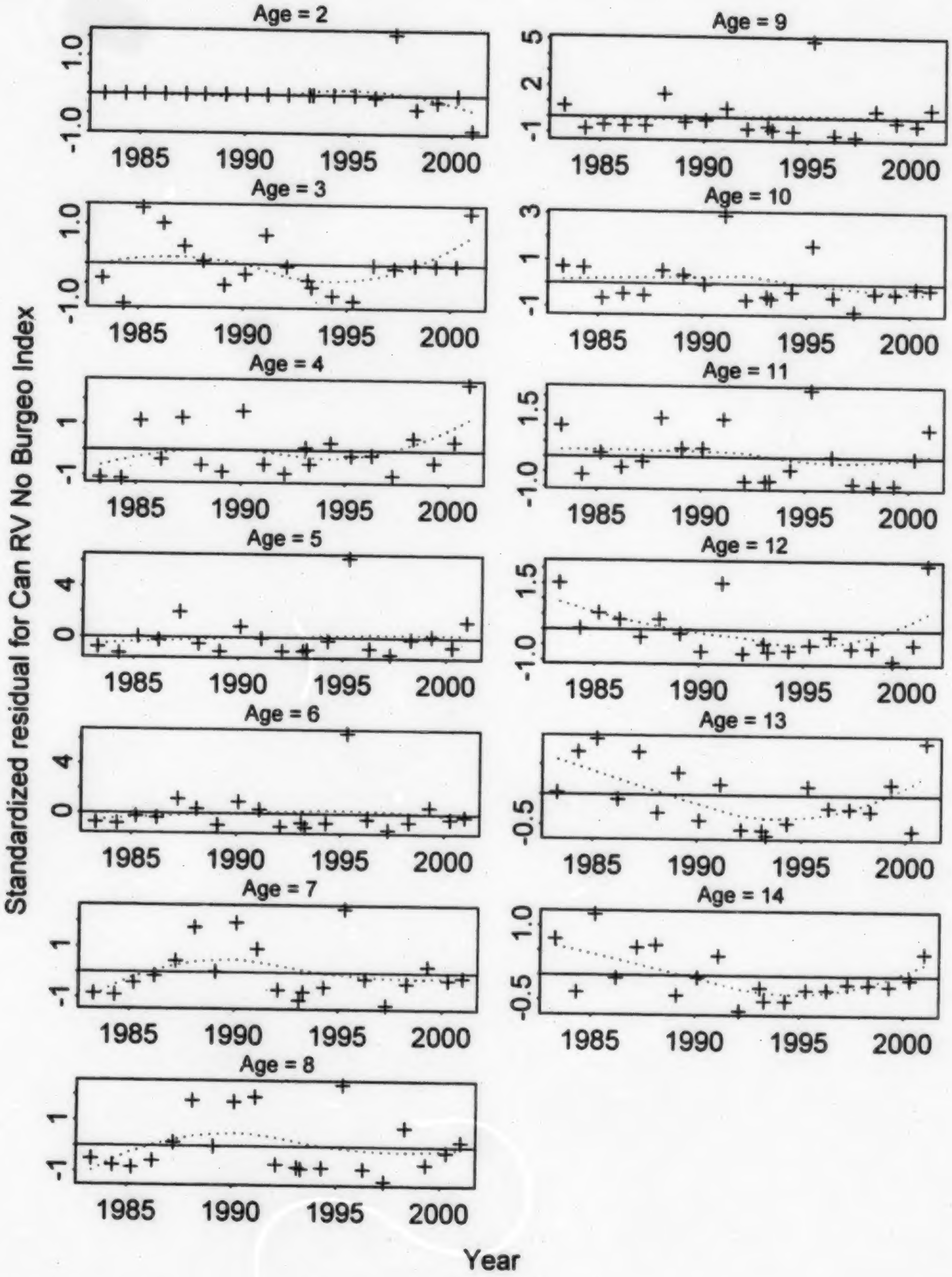

Age = 2
1.0
-1.0
Age = 3
1.0
-1.0
Age = 4
1
-1
Age = 5
4
0
Age = 6
4
0
Age = 7
1
-1
Age = 8
1
-1
Age = 9
5
2
-1
Age = 10
3
1
-1
Age = 11
1.5
-1.0
Age = 12
1.5
-1.0
Age = 13
-0.5
Age = 14
1.0
-0.5
1985
1990
1995
2000
Standardized residual for Can RV No Burgeo Index
Year

Fig. 28. Cont'd.

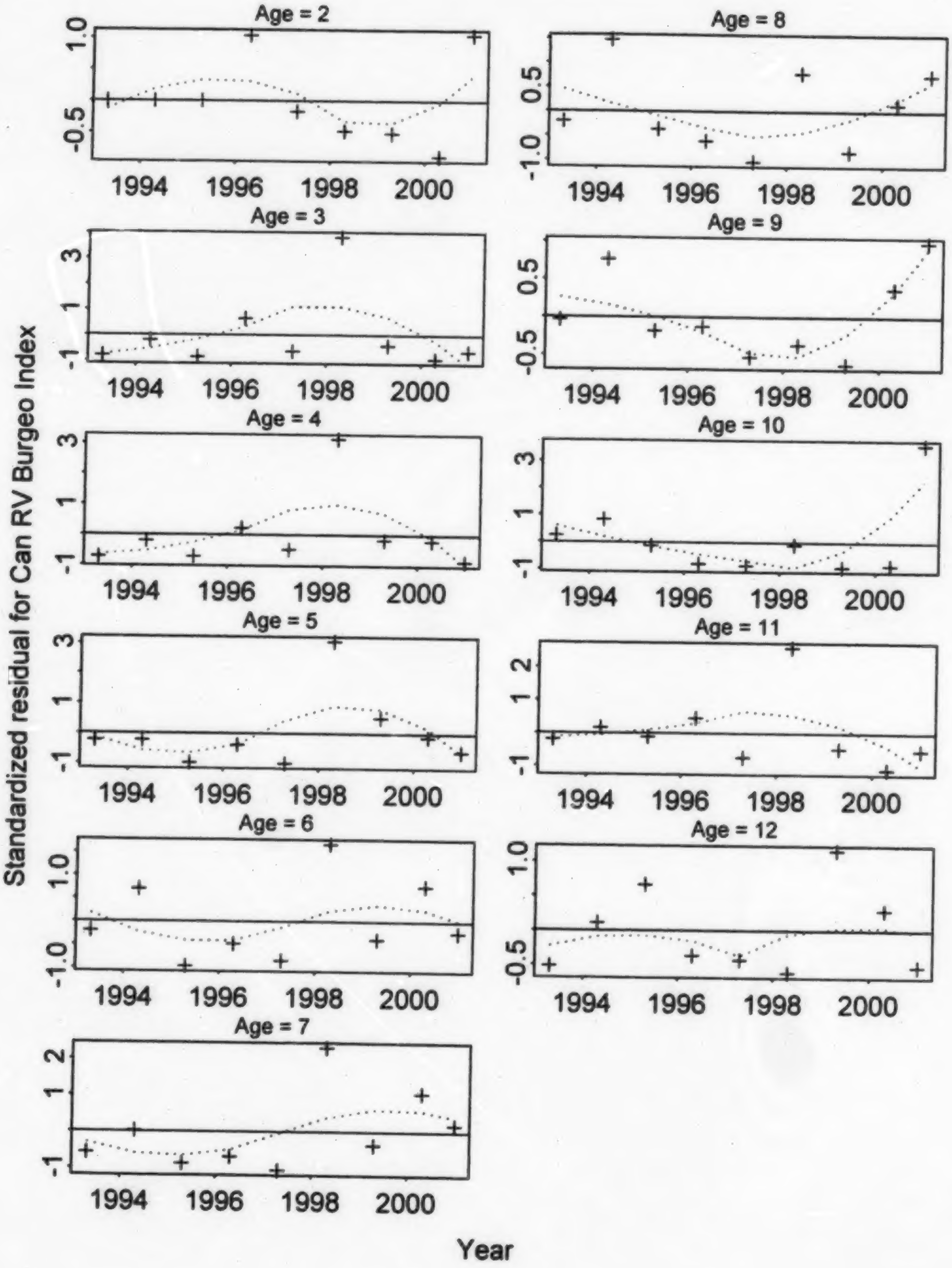

Age = 2
Age = 3
Age = 4
Age = 5
Age = 6
Age = 7
Age = 8
Age = 9
Age = 10
Age = 11
Age = 12
1.0
0.5
-0.5
-1.0
3
2
1
-1
1994
1996
1998
2000
Standardized residual for Can RV Burgeo Index
Year

Fig. 28. Cont'd.

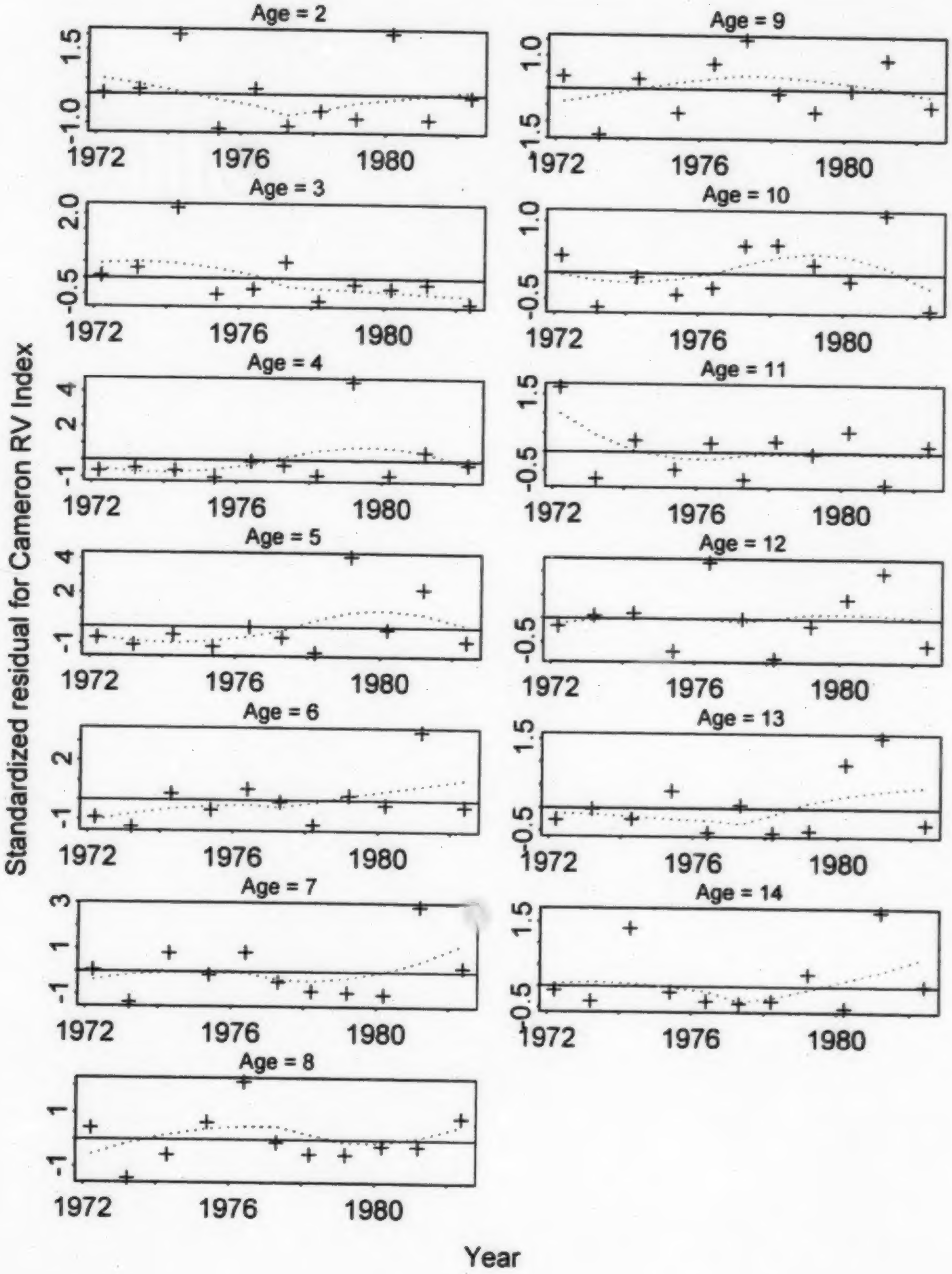

Age = 2
Age = 3
Age = 4
Age = 5
Age = 6
Age = 7
Age = 8
Age = 9
Age = 10
Age = 11
Age = 12
Age = 13
Age = 14
1.5
-1.0
1.0
2.0
-0.5
4
2
-1
3
1
1972
1976
1980
Standardized residual for Cameron RV Index
Year

Fig. 28. Cont'd.

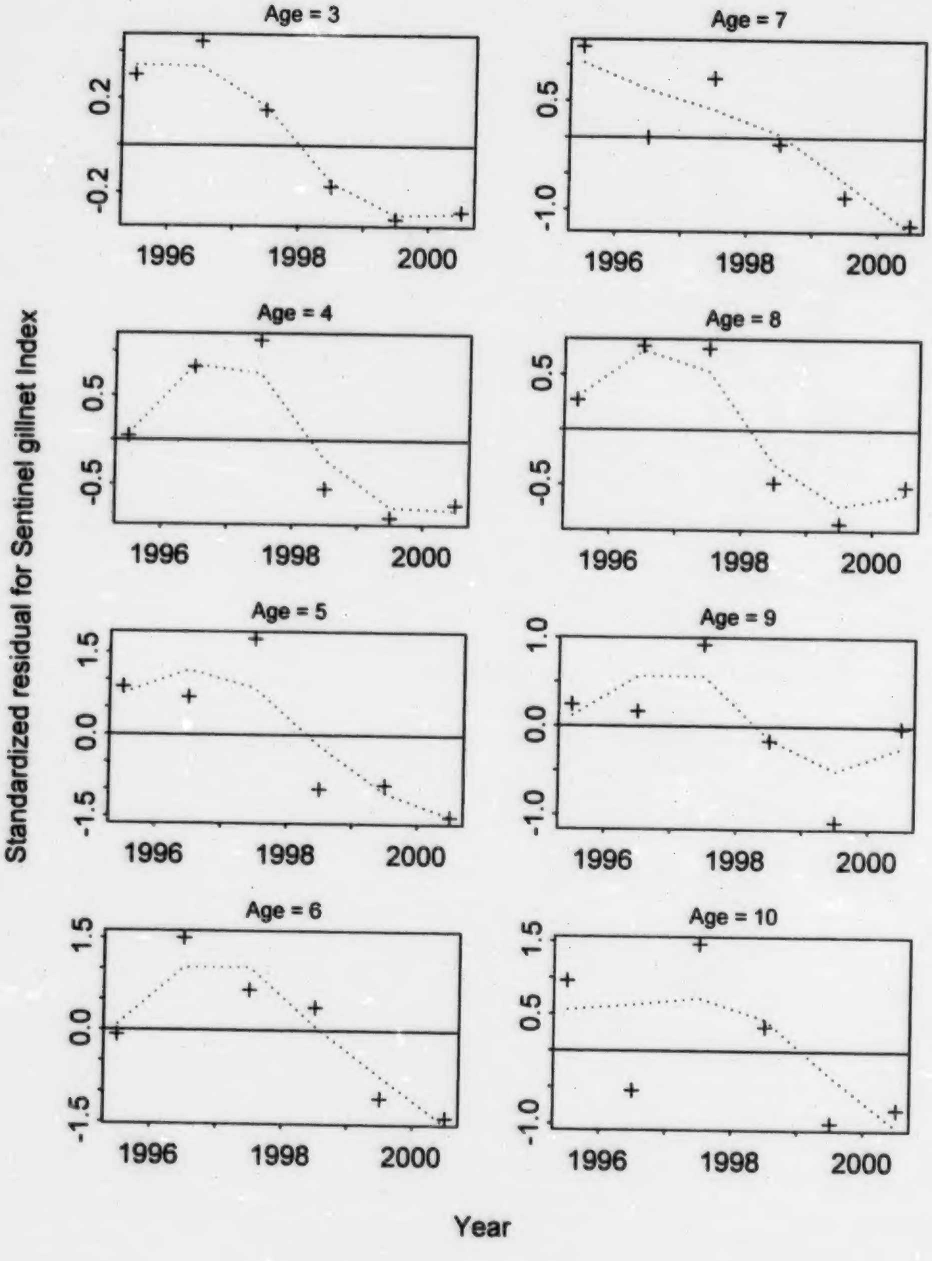
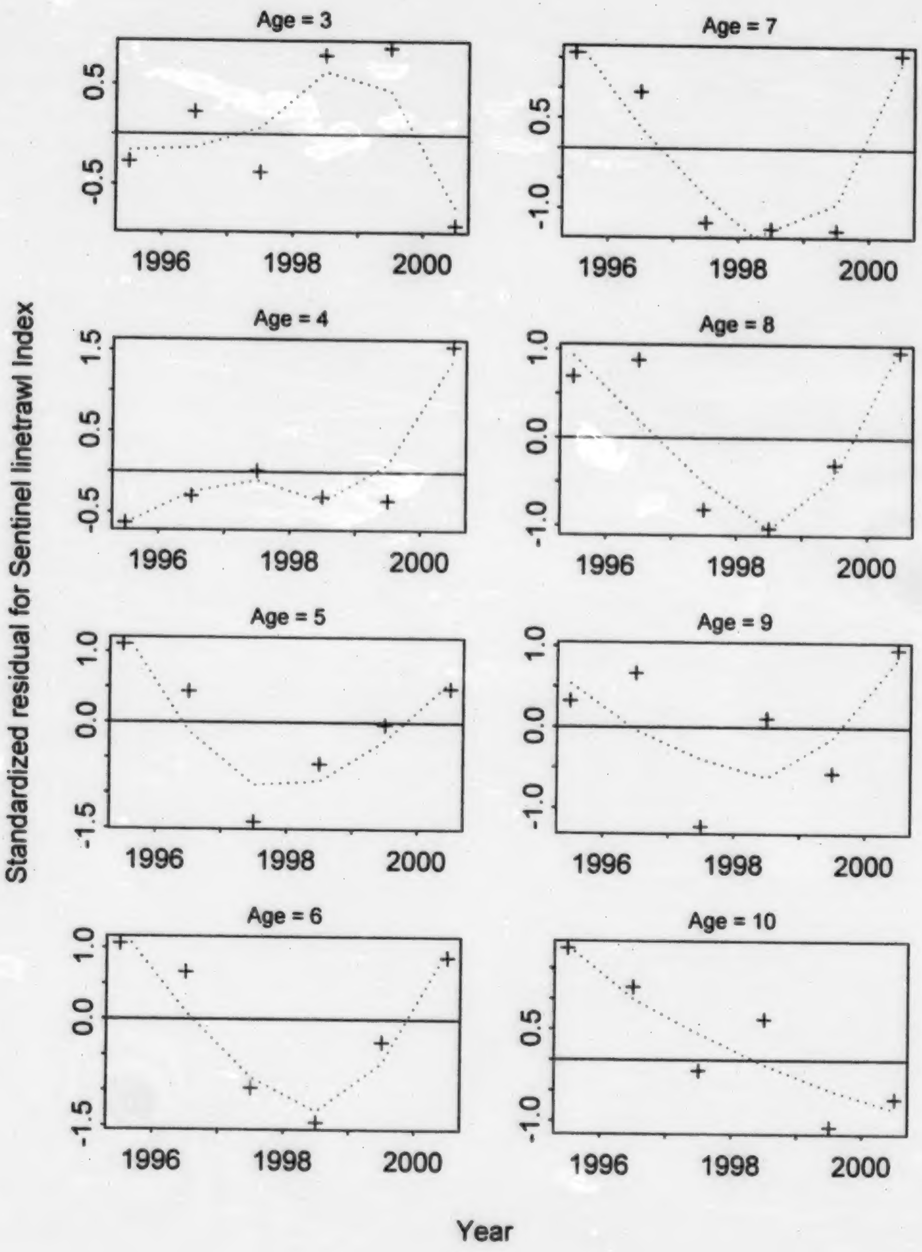

Age = 3
Age = 7
Age = 4
Age = 8
Age = 5
Age = 9
Age = 6
Age = 10
Standardized residual for Sentinel gillnet Index
Year
1996
1998
2000
0.2
-0.2
0.5
-1.0
-0.5
1.5
0.0
-1.5
1.0

Fig. 28. Cont'd.


Age = 3
Age = 7
Age = 4
Age = 8
Age = 5
Age = 9
Age = 6
Age = 10
Standardized residual for Sentinel linetrawl Index
Year
1996
1998
2000
0.5
-0.5
1.5
1.0
0.0
-1.0
-1.5